ATTACHMENT 1
TO RENEWED MOTION TO SEAL

FILED UNDER SEAL

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
SHERMAN DIVISION

THE STATE OF TEXAS, et al.,	§	
	§	
Plaintiffs,	§	Civil Action No. 4:20-cv-00957-SDJ
v.	§	
	§	
GOOGLE LLC,	§	
	§	
Defendant.	§	

GOOGLE'S MOTION TO STRIKE IMPROPER REBUTTAL OPINIONS OF PLAINTIFFS' EXPERTS DAVID DERAMUS AND ANIL SOMAYAJI

Expert rebuttal opinions are not do-overs. Nor are they opportunities to sandbag the opposition by eliciting a response to one opinion only to pivot to another. The "purpose of rebuttal … is just that—to rebut," *Sierra Club, Lone Star Chapter v. Cedar Point Oil Co. Inc.*, 73 F.3d 546, 571 (5th Cir. 1996), which means that a proper "'rebuttal' report explains, repels, counteracts, or disproves evidence of the adverse party's initial report," *CEATS, Inc. v. TicketNetwork, Inc.*, 2018 WL 453732, at *3 (E.D. Tex. Jan. 17, 2018) (quotation omitted); *see also* Fed. R. Civ. P. 26(a)(2)(D)(ii) (defining proper expert rebuttal reports as those "intended solely to contradict or rebut evidence on the same subject matter identified by another party").

Defendant Google LLC ("Google") files this Motion to Strike portions of two of Plaintiffs' recently disclosed "rebuttal" reports that are paradigmatic case-in-chief opinions. The first proffers a brand-new, $132 billion "calculation" in support of the civil penalties Plaintiffs demand as affirmative relief under state DTPA laws—a number more than ***five times larger*** than the largest aggregate penalty proposed by Plaintiffs' initial expert on this same subject. The other introduces brand-new technical analyses of the purported "information advantages" enjoyed by Google's ad buying tools, an allegation that has always been part of Plaintiffs' antitrust case in chief. These improper and untimely "rebuttal" opinions are seriously prejudicial. Both should be stricken.

RELEVANT PROCEDURAL HISTORY

The Court set June 7, 2024 as the deadline for "[d]isclosure of expert testimony … on issues for which the party bears the burden of proof." Dkt. #458.[1] Plaintiffs served reports from six affirmative experts on June 7. Ex. 1 (Ewalt Decl.) ¶ 3. Included were reports from a putative expert on the quantification of civil penalties, Jeffrey Andrien (Ex. 2), and a putative expert in

[1] The June 7 deadline was a three-week extension beyond the Court's original deadline for Plaintiffs' affirmative expert reports. Dkt. #194. Plaintiffs requested that extension to "allow sufficient time for their experts to prepare their opening reports." Dkt. #432 at 8.

computer science, Jacob Hochstetler (Ex. 3).

On July 30, Google served its expert reports, due that day because they addressed "issues for which [Google] does not bear the burden of proof." Dkt. #458.[2] Included among Google's nine reports were (i) reports from Dr. Steven Wiggins (Ex. 4) and Dr. Douglas Skinner (Ex. 5), in response to Mr. Andrien's opinions on civil penalties, and (ii) a report from Dr. Martin Rinard (Ex. 6), partially in response to Hochstetler and otherwise addressing opinions from Plaintiffs' affirmative experts that implicate Google's source code. Ex. 1, ¶ 4.

Plaintiffs next requested and received an extension to their deadline to disclose "rebuttal expert testimony," moving it to September 9. Dkt. #609. On September 9, Plaintiffs served **11** purported "rebuttal" reports, including **5** from previously undisclosed experts. Ex. 1, ¶ 5. These eleven reports together total ~1500 pages. *Id.*

Plaintiffs' newly disclosed "rebuttal" experts include two that opine on subjects plainly within Plaintiffs' affirmative burden of proof. One is a brand-new report on the calculation of DTPA civil penalties—an issue on which Plaintiffs without doubt bear the burden of proof—authored by David DeRamus. In it, Dr. DeRamus purports to ***increase the appropriate cumulative penalty amount by over $100 billion dollars, more than five times the unsupportable and shocking $22 billion sum*** espoused by Plaintiffs' initial civil-penalties expert, Mr. Andrien. *See* Ex. 7 (DeRamus Rpt.). Plaintiffs' "rebuttal" expert Dr. Anil Somayaji also offers a brand-new opinion that, in reality, goes to an element of Plaintiffs' case in chief: anticompetitive conduct as relevant to antitrust liability. Dr Somayaji claims to describe "information advantages" enjoyed by

[2] Two of Google's reports were served August 6, pursuant to the Court's one-week extension for "responsive expert opinions that would … include issues relating to equitable relief for which the party does not bear the burden of proof." Dkt. #562; Ex. 1, ¶ 4.

Google's ad-buying tools when bidding in auctions on Google's ad exchange, an allegation that ***has always been a tenet of Plaintiffs' antitrust theory***, *see* Ex. 8 (Somayaji Rpt.).

ARGUMENT

Drs. DeRamus and Somayaji each proffer untimely affirmative opinions under the guise of "rebuttal" reports. Their improper rebuttal opinions—Sections II.B-C, VI.C-D, and VII.B of the DeRamus report and Sections IV and V of the Somayaji report—should be stricken.[3]

I. Improper rebuttal opinions should be stricken, absent substantial excuse.

"Parties must provide their expert disclosures 'at the times and in the sequence that the court orders,'" and that "requirement extends to designating rebuttal experts and disclosing rebuttal reports 'intended solely to contradict or rebut evidence' in another party's expert reports." *CEATS, Inc. v. TicketNetwork, Inc.*, 2018 WL 453732, at *3 (E.D. Tex. Jan. 17, 2018) (quoting Fed. R. Civ. P. 26(a)(2)(D)). In turn, "Rule 37 sets forth the consequences of untimely or insufficient disclosure by a party: 'The party is not allowed to use that information or witness … unless the failure was substantially justified or is harmless.'" *Id.* (quoting Fed. R. Civ. P. 37(c)(1)).

On motions to strike improper rebuttal opinions, the first question is "whether [the expert] is a rebuttal witness" or instead offers affirmative (and thus untimely) expert opinions. *See United States ex rel. Montcrieff v. Peripheral Vascular Assocs., P.A.*, 507 F. Supp. 3d 734, 746-47 (W.D. Tex. 2020). Courts consider three factors in answering this threshold question: "(1) whether the report is purporting to contradict or rebut expert opinions offered by the opposing party as a claim or defense on which the opposing party has the burden of proof; (2) whether the opinions are on the same subject matter as that identified by the opposing party's expert [report]; and (3) whether

[3] This Motion addresses only the timeliness of Dr. DeRamus's and Dr. Somayaji's improper rebuttal opinions, not their relevance, reliability, or other substantive matters bearing on their admissibility. To the extent not stricken, Google reserves its rights to object on substantive grounds.

the evidence disclosed as rebuttal evidence is intended solely to contradict or rebut that evidence." *Id.* at 747 (quoting *YETI Coolers, LLC v. RTIC Coolers, LLC*, 2017 WL 394511, at *2 (W.D. Tex. Jan. 27, 2017); *see also Gibson Brands, Inc. v. Armadillo Distrib. Enters., Inc.*, 2021 WL 231764, at *1 (E.D. Tex. Jan. 22, 2021) (similar, and collecting cases).

Second, while "[i]mpermissible rebuttal testimony should be excluded," *Gibson Brands*, 2021 WL 231764, at *1, courts consider whether "the failure was substantially justified or is harmless," Fed. R. Civ. P. 37(c)(1), such that a lesser remedy may suffice. Several factors inform this question, too: "(1) the importance of the witnesses' testimony; (2) the prejudice to the opposing party of allowing the witnesses to testify; (3) the possibility of curing such prejudice by granting a continuance; and (4) the explanation, if any, for the party's failure to comply with the discovery order." *Sierra Club, Lone Star Chapter v. Cedar Point Oil Co. Inc.*, 73 F.3d 546, 572 (5th Cir. 1996). When the factors weigh against excusing the untimely disclosure, as when there is "no good explanation for [the] delay in proffering" the opinion, the proper remedy is to strike it. *E.g.*, *CEATS*, 2018 WL 453732, at *4; *Montcrieff*, 507 F. Supp. 3d at 748-49. Alternatively, when the factors weigh in the other direction, as when exclusion would result in a "trial in which only the Defendants have experts," courts may find a lesser remedy appropriate, such as allowing the opposing party to file a sur-rebuttal report. *E.g.*, *9.345 Acres*, 2016 WL 5723665, at *5-6. The Court has "broad" discretion in resolving both questions. *Sierra Club*, 73 F.3d at 569.

II. Dr. DeRamus's improper rebuttal opinions should be stricken.

No law allows any plaintiff to proffer as a purported "rebuttal" an opinion disclosing brand-new methods for calculating damages, because that is an issue on which every plaintiff bears the burden of proof. Just so here, regarding Plaintiffs' "rebuttal" on civil penalties. Permitting Plaintiffs to proceed on an untimely affirmative report adding more than $100 billion to their prior

penalty demand would be profoundly prejudicial to Google—a prejudice made inexcusable by the fact that the Google documents and public-domain "evidence" considered in Dr. DeRamus's report were equally available to Plaintiffs before they served their opening reports in June. Plaintiffs offer no justification for their delay in providing this affirmative report, because there is none. So the "rebuttal" opinions in which Dr. DeRamus purports to tell the jury how to calculate civil penalties, and how much to award, must be stricken.

A. DeRamus offers improper rebuttal opinions.

The DeRamus opinions at issue in this Motion do not correct or rebut Google's experts on civil-penalty metrics. They are an overt attempt at a do-over, providing a backup affirmative penalty calculation should Plaintiffs' initial civil-penalty expert, Mr. Andrien, fail to persuade. Plaintiffs are "trying to improperly use rebuttal to modify [their] case in chief and get a 'do-over,'" but the Federal Rules forbid such gambits. *9.345 Acres*, 2016 WL 5723665, at *4.

Plaintiffs disclosed Mr. Andrien—not Dr. DeRamus—as an affirmative expert on the theory and calculation of civil penalties under the respective Plaintiff states' deceptive trade practices laws ("DTPA"). Mr. Andrien began by counting DTPA "violations" by quantifying the number of transactions (i.e., auctions for ads on Google's AdX exchange) occurring when any of four allegedly deceptive programs were in effect. His "total count" of alleged violations came to [redacted]. Ex. 2, ¶ 101 & tbl. 2.[4] Next, Mr. Andrien opined regarding "a range of per violation penalties" in an amount "between $0.00025 and $0.001" per alleged violation," *id.* ¶ 127, a figure purportedly derived from his analysis of "the deceptive trade practice factors," including in particular the "levels of penalties [that] could have a sufficiently meaningful impact on Google's financial position to act as a deterrence of future violations," *id.* ¶ 129. In the end, Mr. Andrien's

[4] *See also* Ex. 9 (Andrien Rebuttal Rpt.) ¶ 21 (clarifying that he calculated "[redacted] violations"); Ex. 7 (DeRamus Rpt.) ¶ 33 (same as to Andrien's calculation of "[redacted]" "statutory violations").

calculations resulted in a "maximum of $21.81 billion in total penalties." *Id.* ¶ 130.

Google's experts, Drs. Wiggins and Skinner, rebutted and corrected Mr. Andrien's analysis—on Mr. Andrien's own terms. Dr. Wiggins explained that, in a number of ways (including for instance failing to confine the transaction count to U.S. transactions and failing to exclude transactions that could not (even theoretically) have been affected by the allegedly deceptive practices), Mr. Andrien's [redacted] figure for total "violations" was grossly overstated. Ex. 4 (Wiggins Rpt.) § IV. In sum, Dr. Wiggins's analysis revealed that "the de-duplicated number of transactions that potentially could have been affected by the alleged deception falls to [redacted], a [redacted]" from Mr. Andrien's calculation. *Id.* ¶ 166 (emphasis added). Dr. Wiggins also contested Mr. Andrien's calculation of a theoretically optimal per-violation (i.e., per-transaction) penalty, opining instead that any per-violation penalty should, at most, be derived from Google's per-transaction profits, which amounted to [redacted]. *Id.* ¶ 172 & tbl. 2. Dr. Wiggins therefore opined that a proper application of Mr. Andrien's theory results in a maximum penalty of ~$45 million. *Id.* ¶ 180 & fig. 3. Google expert Dr. Skinner added to the necessary corrections of Mr. Andrien's analysis by correcting Mr. Andrien's quantification of the revenues Google earned from the technologies using the allegedly deceptive programs. Whereas Mr. Andrien calculated roughly [redacted] in "display advertising revenue" in the "Plaintiff States," Ex. 2 (Andrien Affirmative Rpt.) ¶ 95 & tbl. 1, a figure Mr. Andrien deemed relevant to calculating a proper per-violation penalty, *id.* at ¶ 13, Dr. Skinner explained that eliminating products unrelated to the allegedly deceptive programs results in substantial reductions to any "display advertising revenue" guidepost. Ex. 5 (Skinner Rpt.) ¶ 50 & tbl. 3, ¶ 57 & tbl. 4A.

On September 9, Mr. Andrien disclosed a rebuttal report taking issue with many of Dr. Wiggins's and Dr. Skinner's corrections. *See* Ex. 9. But Plaintiffs did not stop there. They also

disclosed Dr. DeRamus's "rebuttal," which offers not one, but ***two brand-new methodologies and calculations of more than $132 billion in new civil penalties***.

His first proffered methodology is that a "socially optimal penalty" may be calculated by a mathematical formula, dividing the "gains" obtained from the "harmful act" by "the probability of enforcement." *Id.* § II.B & ¶¶ 28-29. In this vein, he opines that although under the DTPA "penalties are assessed on a per-violation basis," given the large numbers of violations at issue, it makes no difference "whether the relevant number of statutory violations is the number calculated by Dr. Wiggins [redacted] or Mr. Andrien ([redacted])"—a complete abdication of Mr. Andrien's approach. *Id.* ¶¶ 33 & fig. 1.

Second, Dr. DeRamus offers another theoretical methodology to calculate civil penalties. He claims that the "principal-agent problem" inherent in large, public corporations (where shareholders' ownership is divorced from control by management) means that a proper penalty should be calculated to cause a material drop in the corporation's stock price. *Id* § II.C & ¶ 43 ("Unless a penalty amount is large enough to have a sufficiently large impact on the stock price, thus spurring the shareholders to monitor management, it would be ineffective….").

Those methodological opinions (§§ II.B and II.C) are themselves improper rebuttals. But Dr. DeRamus does not just theorize regarding the two brand-new methodologies the jury might use to quantify penalties. He then purports to ***actually calculate two sets of brand-new "ranges" of civil penalties for the jury's consideration***, with each set applying one of his new theoretical methodologies. To implement his gain-divided-by-enforcement-probability formula (§§ VI.C and VI.D), Dr. DeRamus (i) estimates the "probability of detection, enforcement, and penalty collection" by deriving—from purported analogs in antitrust-conspiracy enforcement and FDA actions for tobacco-law violations—a "range of between 10%–33%" for the purported "*ex ante*

probability," *id.* § VI.C & ¶¶ 103-04, 108; and (ii) estimates Google's subjective, "*ex ante* expected value of the benefits at the time the [allegedly deceptive] conduct began," for each of three categories of allegedly deceptive conduct, *id.* § VI.D. Ultimately, after applying a range of "annual growth" rates, and his range of 10%–33% for the "probability of enforcement," combined with lay evidence of Google employees' expectations about the value of each program at issue, ***Dr. DeRamus proffers brand-new affirmative penalty calculations ranging from $9.2 billion to $132.4 billion.*** These figures, as well as the underlying formula and methodology, appear for the first time in this case in Dr. DeRamus's "rebuttal" report, *id.* ¶ 117 & fig. 16:

Category	Scenario	Incremental revenue	Incremental profit	Profit-based deterrent penalty, using probability of detection:		
				33%	20%	10%
Incremental benefit as of 2013	3% annual growth	[redacted]				
	5% annual growth					
Incremental benefit as of June 2025	3% annual growth					
	5% annual growth					

Dr. DeRamus next calculates ***another set of brand-new penalty figures*** (§ VII.B) based on his *second* brand-new methodology (the one turning on the amount necessary to cause "a substantial drop in Google's stock price." *Id.* § VII & ¶ 128). He first purports to catalog the impacts on Google's stock price of "48 instances where Google was subjected to a fine or settlement on account of its conduct." *Id.* ¶ 135. According to Dr. DeRamus, he then performs "event studies"—statistical analyses of stock-price impacts, controlling for standard deviations and market-wide trends—for the instances in which such fines, or investigations later leading to fines, were announced. *Id.* Ultimately, Dr. DeRamus concludes that the only instance (a "noticeable exception") in which a Google stock-drop exceeded a "modest magnitude" was when the European Commission announced an "investigation of Google Search … in late 2010," which led—eight years later—to fines totaling $9.5 billion. *Id.* ¶ 140. Because Dr. DeRamus believes

that the announcement of an investigation leading, many years later, to a $9.5 billion fine is the only event to have had a sufficiently "appreciable" impact on Google's stock price, he then "calculate[s] the equivalent total penalty that could have a similar impact on Google's stock return." Using "various methods," Dr. DeRamus arrives at an aggregate penalty of "at least $12 billion" and as much as "$25 billion" (with the latter figure purporting to account for the growth, since 2010, in Google's total market capitalization). *Id.* ¶¶ 142-146. Neither Dr. Wiggins, Dr. Skinner, nor any other Google expert used Google's historical stock prices to assess an appropriate penalty for the discrete conduct at issue in this case. Dr. DeRamus's second set of penalty calculations, like his first, is a ***brand-new affirmative calculation asserting many billions of dollars in penalties, offered for the first time on "rebuttal."***

Each factor courts consider when determining if a rebuttal opinion is actually a rebuttal opinion shows that these are affirmative opinions, not "rebuttals." The Plaintiff States bear the burden of proof when seeking to enforce the DTPA. *State v. Vavro*, 259 S.W.3d 377, 382 (Tex. App.—Dallas 2008, no pet.). That burden includes justifying DTPA remedies like civil penalties. *See State v. Bachynsky*, 770 S.W.2d 563 (Tex. 1989) (reversing judgment for State, awarding DTPA civil penalties, because State's evidence was insufficient to support aggregate penalty award). Dr. DeRamus, in offering new methods for calculating and actual calculations of civil penalties, is not "contradict[ing] or rebut[ting] expert opinions … ***on which the opposing party has the burden of proof***." *Montcrieff*, 507 F. Supp. 3d at 747 (emphasis added). He opines strictly in support of a paradigmatic element of Plaintiffs' case in chief—the calculation of monetary relief.

Neither can Dr. DeRamus's brand-new methodologies and calculations be construed as "intended solely to contradict or rebut" Google's experts on "subject matter [they] identified." *See id.* at 747. Google's experts did not "identify" Plaintiffs' framework for and calculation of

appropriate civil penalties—Plaintiffs' expert Mr. Andrien did that. Google's experts (Drs. Wiggins and Skinner) then properly corrected Mr. Andrien's underlying calculations and assumptions. *See 9.234 Acres*, 2016 WL 5723665, at *3 ("[A] rebuttal witness must respond to ***new opinions brought out in her opponent's case in chief***.") (emphasis added). That Google's experts disagreed with and corrected Mr. Andrien's civil-penalty opinions does not open the door, on rebuttal, to brand-new affirmative civil-penalty opinions.[5]

Nor can Plaintiffs have been surprised that Google's experts would address Mr. Andrien's calculation of *$22 billion* in civil penalties based on [redacted] "violations." So, even if Dr. DeRamus's calculations tangentially contradicted Dr. Wiggins's or Dr. Skinner's opinions (and they do not), they would still be improper rebuttal opinions—because a witness who "contradict[s] an *expected and anticipated* portion of the opposing party's case in chief can never be considered a rebuttal witness." *9.234 Acres*, 2016 WL 5723665, at *3 (emphasis original).

B. The appropriate remedy is to strike Dr. DeRamus's non-rebuttal opinions.

The "[m]ost significant[]" factors determining whether to strike an untimely expert opinion are the sponsoring party's "explanation for its delay" and whether the information was available "before the deadline for its initial expert reports." *CEATS*, 2018 WL 453732, at *4; *see also Daedalus Blue LLC v. SZ DJI Tech. Co., Ltd.*, 2022 WL 831619, at *4 (E.D. Tex. Feb. 24, 2022) (collecting cases: "Courts routinely reject untimely 'supplemental' expert testimony where the opinions are based upon information available prior to the deadline for expert disclosure.").

Plaintiffs offered no reason that Dr. DeRamus's calculations of penalty "ranges" could not

[5] *See Ainsworth v. Circle K Convenience Store, No. 3721*, 56 F.3d 1386, at *1-2 (5th Cir. May 25, 1995) (defense expert's disagreement with plaintiff's expert was not a basis to allow rebuttal expert because the subject matter "was not new"); *McReynolds v. Matthews*, 2017 WL 5573194, at *4 (S.D. Miss. Nov. 20, 2017) (defense expert opinion on "essential element of [plaintiff's] claim," is not "new information that would be proper grounds for a rebuttal").

have been disclosed in June, as required by the Scheduling Order. They undoubtedly could: the information on which he relies—public stock-market information, historical enforcement rates by federal agencies, and documents produced in discovery—were all available then. There is no excuse. *See Sierra Club*, 73 F.3d at 573 (affirming exclusion where it "was clear from the filing of the action" that subject matter of expert's testimony "would be an issue in this lawsuit").

Other considerations also support striking these opinions. The "prejudice" to Google, *see id.* at 572, speaks for itself. Google has now been confronted with a new, affirmative opinion demanding as much as $132 billion in penalties—over five times the amount Google believed its experts had to rebut based on the (timely) report of Plaintiffs' first penalty expert, Mr. Andrien. Now, rather than the allotted five months between Plaintiffs' affirmative reports, and the need to file summary-judgment and *Daubert* motions in November, Google is left with just two months in the interim, during which time nineteen expert depositions must be completed. *See id.* (finding sufficient prejudice where a party "should have received most of this information in initial expert disclosures a month earlier"). This prejudice cannot be cured by affording Google a surrebuttal. There is not enough time for an econometric expert to prepare a comprehensive critique of Dr. DeRamus's purported stock-market event study and to assess Dr. DeRamus's "estimation" of percentage-probabilities of enforcement, then prepare for and conduct appropriate depositions, by the close of expert discovery on November 1 (a deadline Plaintiffs refuse to extend). *See YETI Coolers*, 2017 WL 394511, at *3 (party "would be prejudiced if [expert's] report is allowed, because it would be unable to rebut [expert's] opinion with an expert of its own").[6] Plaintiffs, in

[6] If the Court instead chooses to grant Google leave to prepare sur-rebuttal reports, the expert discovery schedule would have to be extended by *at least* seven weeks to allow Google adequate time to prepare comprehensive surrebuttal reports and conduct depositions–a delay that would impose cascading delays in the summary judgment and *Daubert* schedule, as well as the March trial date. The only way to maintain the current schedule, without prejudice to Google, is to strike these improper, untimely affirmative opinions.

contrast, are not prejudiced by exclusion of these untimely opinions. They, not Google, chose to designate only Mr. Andrien to testify affirmatively on metrics purportedly bearing on the calculation of civil penalties. And Mr. Andrien remains available to do so.

Further, should Plaintiffs be permitted to use Dr. DeRamus as a "do-over" on Mr. Andrien's subject matter, Google will have "expended considerable resources responding to [Andrien's] initial opinions," only to now "undoubtedly … expend significantly more time and money addressing [DeRamus's] new opinions." *See Daedalus Blue*, 2022 WL 831619, at *4. The "Fifth Circuit has been clear that district judges have the power to control their dockets by refusing to give ineffective litigants a second chance to develop their case." *Id.* at *4; *accord Hamburger v. State Farm Mut. Auto. Ins. Co.*, 361 F.3d 875, 884 (5th Cir. 2004) (violation of a scheduling order is not a ground for continuance). Finally, if Dr. DeRamus's new penalty opinions were so "important," *see Sierra Club*, 73 F.3d at 572, as to excuse Plaintiffs' sandbagging tactics, they should have been disclosed on or before the deadline for case-in-chief expert testimony. *See YETI Coolers*, 2017 WL 394511, at *3 (the "importance of [expert's] testimony" was "not enough to save" it because the "deadline was well known," as was which party "bears the burden of proof").

II. Dr. Somayaji's improper rebuttal opinions should be stricken.

Dr. Somayaji does pay lip service to his purported role as a "rebuttal" expert. He frames his opinions that "Google's ad buying tools have access to more granular targeting information," Ex. 8 (Somayaji Rpt.) § IV, ¶ 24, and that "Google uses undisclosed internal data to calculate bids," *id.* § V, ¶ 43, as somehow responsive to Google expert Paul Milgrom's opinion that bidders in AdX auctions could "optimize their behavior in response to Google's changes to its auction programs," *see id.* ¶ 24; *see also* ¶ 43 (same as to § V). But Dr. Milgrom's report, which Dr. Somayaji purports to "rebut," has nothing to do with computer source code (Dr. Milgrom is an

economist), and offers no comparison of the information provided to Google and non-Google ad buying tools. On the contrary, Dr. Milgrom opines on what publishers, advertisers, and non-Google buying tools can do to optimize auction outcomes with the information they have—without reference to whether Google's tools have access to more, less, or the same information as non-Google tools. *See generally* Ex. 10 (Milgrom Rpt.). Dr. Somayaji acknowledges as much, even chastising Dr. Milgrom for explaining what optimization and experimentation is practicable "***without addressing*** … the information imbalance" between Google and non-Google buying tools. Ex. 8, ¶ 43 (emphasis added); *see also id.* ¶ 24 ("[Milgrom] ignores the fact that vastly different amounts of information are shared with Google's ad buying tools compared to third-party buyers."). Put simply, Dr. Somayaji claims to "rebut" an opinion never offered by Dr. Milgrom (or any other Google expert), namely that Google buying tools have no more information than non-Google tools. That is not rebuttal. *See 9.345 Acres*, 2016 WL 5723665, at *3 ("Rule 26 defines a proper expert rebuttal report as one that is 'intended solely to contradict or rebut evidence on the same subject matter identified' by the opposing party's case in chief expert report.").[7]

It appears Plaintiffs always intended to offer the opinions in Sections IV and V of Dr. Somayaji's "rebuttal" report. Nothing in Google's expert reports could have *unexpectedly* provoked this analysis. These Sections opine that Google's ad buying tools had access to "more granular" information "than do third-party buyers," and that Google, unlike third-party bidders, could use "undisclosed internal data to calculate bids using predictive models." Both opinions are purportedly derived through "review of Google's source code," the "produced Google ad infrastructure code," and "Google documentation." Ex. 8, ¶¶ 25, 43. None of this addresses Dr.

[7] Tellingly, Dr. Somayaji—a computer scientist—offers no rebuttal to Google's computer science expert Dr. Rinard. *See* Ex. 8 (Somayaji Rpt.) ¶ 3 and *passim* (acknowledging review of Dr. Rinard's report but not responding to it). Plaintiffs must also admit source-code opinions bear on their case in chief: their affirmative reports in June included a ~200-page report from computer scientist Dr. Hochstetler. Ex. 3.

Milgrom's analysis. Instead, it all relates to an element of Plaintiffs' as-alleged case in chief: the competitive advantages Google allegedly held as a result of its superior technology.

Plaintiffs cannot contend otherwise. The Court need look no further than their Complaint, which explicitly alleges the anticompetitive effect of the very "information asymmetry" Dr. Somayaji describes. Plaintiffs have *always* claimed that Google allegedly "foreclosed competition" through the technological design of its ad exchange, AdX, by "provid[ing] its buying tools (DV360 and Google Ads) with information advantages when bidding." Dkt. #541 (4th Am. Compl.) ¶ 276; *see also id.* ¶ 77 (alleging that Google uses "their control of the exchange to give preferred access to their own buying tools," including by "withholding relevant information" from "non-Google buying tools").[8] That alleged buy-side informational advantage is the *affirmative claim* Dr. Somayaji's "rebuttal" report claims to demonstrate. *See* Ex. 8, § V, ¶ 47 ("… first-party bidders in Google's internal auctions (i.e., Google's buying tools) … have a significant information advantage over third-party ad bidders."); *id.* § IV, ¶ 42 ("Google creates an information imbalance that favors its customers over [other] buyers."), ¶ 38 (Google Ads "can make determinations based on the degree to which [] information is consistent, accurate, and precise in a way that [other] bidders cannot."), ¶ 30 (describing "three examples of data categories where an information imbalance is present").

Dr. Somayaji is not rebutting anything. He is offering evidence for one of Plaintiffs' original, and affirmative, theories of antitrust liability. His opinions do not "contradict or rebut expert opinions … on which [Google] has the burden of proof," *see Monctcrieff*, 507 F. Supp. 3d at 747, because it is Plaintiffs' burden to prove their theory of anticompetitive conduct. *Retractable*

[8] *See also* Dkt. # 1 (Orig. Complaint filed 12/16/2020) ¶ 238 (alleging that Goolge's "exchange and ad server provide Google's buy-side with information advantages and better opportunities"), ¶ 251 ("Google has unlawfully maintained monopolies by … [s]ubstantially foreclosing competition in the markets for display ad buying tools … by creating information asymmetry ….").

Techs., Inc. v. Becton Dickinson & Co., 842 F.3d 883, 891 (5th Cir. 2016). Dr. Somayaji seeks to help Plaintiffs meet that affirmative burden, which means Sections IV and V are not "rebuttal" opinions. And he *certainly* cannot be rebutting Dr. Milgrom, as he claims, because he offers a "new data set" that Milgrom did not address (Google's source code) and a "new means of analysis" (source code review) that Dr. Milgrom was neither asked nor qualified to utilize. *See White v. State Bd. of Elec. Comm'rs*, 2023 WL 2957819, at *4 (N.D. Miss. Apr. 14, 2023) (opinion offering "an entirely new data set and new means of analysis" was "plain[ly] … not proper rebuttal").

Dr. Somayaji's Sections IV and V should be stricken because the *Sierra Club* factors weigh against any lesser remedy. Plaintiffs cannot offer any legitimate "explanation" for failing to disclose Dr. Somayaji's opinions in June—their relevance "was clear from the filing of the action," and all parties knew that Google's source code "would be an issue in this lawsuit." *See Sierra Club*, 73 F.3d at 573. The code and Google documents on which Dr. Somayaji relies were no less available in June, "before the deadline for [Plaintiffs'] initial expert reports." *See CEATS*, 2018 WL 453732, at *4. And Dr. Somayaji's improper rebuttals are prejudicial for the same reasons as Dr. DeRamus's, including in particular that Google "should have received [] this information in initial expert disclosures" in June, *see Sierra Club*, 73 F.3d at 572, leaving time to develop responsive expert testimony and undertake the time- and resource-intensive review of source code required to do so.

CONCLUSION

Google respectfully requests that the Court strike, and exclude any testimony from these two experts regarding, the untimely affirmative opinions disclosed in Sections II.B-C, VI.C-D, and VII.B of the DeRamus report and Sections IV and V of the Somayaji report.

Dated: September 20, 2024

Respectfully submitted,

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ATTORNEYS FOR
DEFENDANT GOOGLE LLC

CERTIFICATE OF SERVICE

I certify that on September 20, 2024, this document was filed electronically in compliance with Local Rule CV-5(a) and thus served on all counsel who have consented to electronic service.

/s/ *Michael Davis*
Michael Davis

CERTIFICATE OF CONFERENCE

I certify that counsel for Defendant conferred with counsel for Plaintiffs via email and via telephone conference (Google: R. McCallum, Plaintiffs: Z. DeRose) and that counsel for Plaintiffs stated Plaintiffs' opposition to the relief requested in this Motion.

/s/ *Michael Davis*
Michael Davis

CERTIFICATE OF MOTION TO SEAL

I certify that contemporaneously with the filing of this Motion, Defendant is filing a motion to seal both this document and the expert reports attached as exhibits.

/s/ *Michael Davis*
Michael Davis

EXHIBIT 1

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
SHERMAN DIVISION

The State of Texas, et al., Plaintiffs, v. Google LLC, Defendants.	Case No. 4:20-cv-00957-SDJ Hon. Sean D. Jordan

DECLARATION OF ANDREW EWALT

I, Andrew Ewalt, pursuant to 28 U.S.C. § 1746, hereby declare as follows:

1. I am an partner at the law firm Freshfields Bruckhaus Deringer US LLP, which represents Defendant Google LLC ("Google") in the above-captioned case. In this capacity, I am personally aware of and familiar with the various documents served by the parties in the case, including expert reports. I am an attorney admitted to practice in the U.S. Supreme Court, numerous federal courts, and the District of Columbia, Massachusetts, and Pennsylvania. I have been admitted to appear *pro hac vice* in the above-captioned case.

2. I submit this Declaration in support of Google's Motion to Strike Improper Rebuttal Opinions of Plaintiffs' Experts David DeRamus and Anil Somayaji (the "Motion"), dated September 20, 2024. I have reviewed the Motion and am familiar with the exhibits attached thereto.

3. On June 7, 2024, the Plaintiffs in this case served Google with six expert reports, including a report authored by Jeffrey Andrien (a true and correct copy of which is attached to the Motion as Exhibit 2), and a report authored by Jacob Hochstetler (a true and correct copy of which is attached to the Motion as Exhibit 3).

4. On July 30, 2024, Google served Plaintiffs with seven expert reports, and on August 6, 2024, Google served Plaintiffs with two additional expert reports. The seven reports served on July 30 included a report authored by Steven Wiggins (a true and correct copy of which is attached as Exhibit 4 to the Motion), a report authored by Douglas Skinner (a true and correct copy of which is attached as Exhibit 5 to the Motion), a report authored by Martin Rinard (a true and correct copy of which is attached as Exhibit 6 to the Motion), and a report authored by Paul Milgrom (a true and correct copy of which is attached as Exhibit 10 to the Motion).

5. On September 9, 2024, Plaintiffs served Google with eleven expert reports, five of which were authored by previously undisclosed expert witnesses, including a report authored by David DeRamus (a true and correct copy of which is attached as Exhibit 7 to the Motion), and a report authored by Anil Somayaji (a true and correct copy of which is attached as Exhibit 8 to the Motion). Plaintiffs also served, on September 9, a second expert report authored by Jeffrey Andrien, a true and correct copy of which is attached to the Motion as Exhibit 9. The eleven reports Plaintiffs served on September 9 together total about 1500 pages.

6. I declare under penalty of perjury that the foregoing is true and correct.

Executed on the 20th day of September, 2024, in Kensington, Maryland.

/s/ Andrew Ewalt

Andrew Ewalt

EXHIBIT 2

UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF TEXAS

STATE OF TEXAS et al., Plaintiffs vs. GOOGLE LLC, Defendant	Case Number 4:20-cv-00957

EXPERT REPORT OF JEFFREY S. ANDRIEN

JUNE 7, 2024

HIGHLY CONFIDENTIAL

I. INTRODUCTION

A. Qualifications

1. I am the Senior Managing Director in charge of Coherent Economics' ("Coherent") Austin, Texas office. Coherent is a privately held economic consulting firm with offices in Illinois and Texas. Coherent provides litigation support, expert witness, valuation, and other consulting services to clients throughout the country. Prior to working at Coherent, I held managerial positions at other nationally recognized consultancies.

2. My experience as a business advisor and consultant has included the study of numerous economic and financial issues related to litigation disputes, including damages quantifications and/or liability assessments for matters involving fraud, breach of contract, bankruptcy, securities, intellectual property, antitrust, deceptive practices, and consumer protection, among others. I have been retained by state and local governments, federal government agencies, individuals, and private companies on civil and criminal cases. My studies have been performed across a wide array of industries, including the high tech, real estate, retail, food and beverage, aviation, medical device, energy, and pharmaceutical industries. I have authored several expert reports and have testified in deposition and at trial in state and federal courts across the country. Additionally, I have been recognized by industry press as one of the top economic experts in the United States.-

3. In addition to my responsibilities as a consultant, I work as a lecturer in the Finance Department at The University of Texas' McCombs School of Business ("McCombs"), where I teach a core MBA-level corporate finance class, as well as a graduate-level applied finance course. I have also taught finance, marketing, and economics classes at other universities, both domestically and abroad, including at Washington University's Olin School of Business in St.

Louis, Missouri and Thammasat University in Southeast Asia. Additionally, I routinely make presentations on commercial damages, finance and valuation, and intellectual property issues to law firms, professional societies, and scholastic institutions.

4. I hold a B.A. in Economics and an M.B.A. from the University of Texas at Austin. A copy of my curriculum vita and testimony experience for at least the past ten years is attached to this report as **Appendix 1.**

B. Compensation Disclosure

5. Coherent is compensated at the rate of $620 per hour for my time on this matter. Research and analysis for this report was also performed by consultants at Stout, a global advisory firm, and Coherent under my supervision, direction, and instruction. Hourly rates for these consultants range from $290 to $600 per hour. My compensation and that of Coherent and Stout is not determined by the outcome of this case.

C. Documents Considered

6. In conducting my analysis, I, and/or others working under my guidance, direction, and supervision have reviewed certain documents, data and other information produced by the parties to this litigation, as well as publicly available information. I have been provided access to the document database as well as all depositions related to this litigation. The information I have considered and/or relied upon to date in forming my opinions is listed in **Appendix 2** of this report.

D. Allegations and Summary of Assignment

7. I have been retained by the Lanier Law Firm PC, counsel for certain states on behalf of all states that are plaintiffs in this matter (collectively, the "Plaintiff States")[1] to serve as an

[1] *See* Fourth Amended Complaint in *State of Texas et al. vs. Google LLC*, In Re: Google Digital Advertising Antitrust Litigation, Civil Action No. 1:21-cv-06841-PKC, May 5, 2023 ("Complaint"). The plaintiffs in this lawsuit are States of Alaska, Arkansas, Florida, Idaho, Indiana, Louisiana, Mississippi, Missouri, Montana, Nevada, North Dakota, South Carolina, South Dakota, Texas, and Utah, and the Commonwealths of Kentucky and Puerto Rico, .

expert witness in the above-referenced matter. I understand that the Plaintiff States allege that Google, LLC ("Google"), formerly known as Google, Inc. and a subsidiary of the holding company, Alphabet, Inc.,[2] engaged in unfair, false, deceptive, and misleading business acts and practices related to its display advertising technology and changes it made to its ad buying tools and to auctions conducted on its AdX advertising exchange during at least the period 2013 to the present.[3] Furthermore, I understand that the Plaintiff States are seeking civil penalties under each State's deceptive trade practices statutes.[4] I have been asked to analyze certain factors that I understand are relevant to determining the applicable statutory penalties in this matter. In particular, I address the amount necessary to deter future misconduct, the history of past violations, and the ability of the offending party to pay a penalty, though as discussed below, there are additional factors that a trier of fact may consider in assessing an appropriate penalty amount.

8. My analysis, evaluation, and opinions ("study") discussed in this report are based on certain assumptions, including the assumption that Google is found liable for the alleged misconduct. No opinions on liability are expressed herein.

9. My study is further based upon my skills, knowledge, experience, education, and training, as well as publicly available information, deposition testimony, certain reports prepared by other experts in this matter, and the currently available documents, information, and materials produced in connection with this litigation, to which I was provided full access. I am in a position to render my opinions at this time based upon such information and my qualifications. I

[2] Google Inc. created the parent company Alphabet Inc. in August 2015. *See* "Google Creates Parent Company Called Alphabet in Restructuring," Wall Street Journal, August 10, 2015. Two years later, in September 2017, the Google Inc. subsidiary was converted to Google, LLC. *See* Alphabet 10-K for the fiscal year ended December 31, 2017. When referring to Google's financial performance, I use the term "Google" to refer to both Google and Alphabet, Inc. throughout this report.
[3] *See* Complaint at ¶¶298, 552 discussing the launch of Project Bernanke.
[4] The Plaintiff States have also brought antitrust claims against Google in this matter; however, my opinions are limited to those claims related to deceptive trade practices.

respectfully reserve the right to revise or expand my opinions to reflect any additional opinions I may formulate based upon newly acquired information that may become available to me up to and during the time of trial, including but not limited to Google or any third-parties making additional witnesses available for depositions, further production of documents or other materials by Google or any third-parties, and any further responses, supplements, or amendments to any discovery responses. I also reserve the right to respond to opinions of expert witnesses engaged by Google.

10. In connection with my anticipated trial testimony in this action, I may use as exhibits various documents produced in this litigation, which refer to or relate to the matters discussed in this report. In addition, I may create or assist in the creation of demonstrative exhibits to assist me in my testimony.

II. SUMMARY OF OPINIONS

11. Based on my analysis of documents and information I have reviewed in this case, and my education, training, and experience, I hold the following opinions:

a. Google's financial performance during the period 2013 to present has been extraordinary.[5]

   i. From 2013 to 2023, Google's gross revenue totaled \$1.73 trillion, and its operating income totaled \$441.98 billion. Google's revenue grew by a compound annual growth rate ("CAGR") of 18.7% from 2013 to 2023. To put this into perspective, the revenue of the average S&P 500 company experienced a 5.0% CAGR over the same period. Google's operating profit

[5] Throughout this report, I use information currently available to me, including annual income statement data through December 31, 2023, to make comparisons across years and calculate growth rates. I also report Google's Q1 2024 revenues and earnings based on its latest available quarterly filing. Finally, I report balance sheet data as of March 31, 2024, based on Google's latest available quarterly filings. I reserve the right to update my analyses based on updated financial and other information made available by Google, as well as publicly available information, up to and during the time of trial.

has grown by a CAGR of 18.5% from 2013 to 2023. The operating profit of the average S&P 500 company experienced a 5.6% CAGR over the same period.

ii. As of March 31, 2024, Google held cash, cash equivalents, and marketable securities totaling $108.09 billion.

iii. Google is the fourth largest publicly traded company in the world by market capitalization, with a market capitalization of $2.15 trillion as of June 3, 2024.

b. Google's growth and profitability have been driven by advertising. Google's advertising operating profit for 7 of the reported 11 years 2013 to 2023 exceeded its overall operating profit.

c. [redacted]. [redacted]

d. The relevant metric to count violations is all AdX Open Auctions during the time that the misconduct occurred. I have determined that:

i. From 3/31/2015 to 9/25/2019 [redacted]

ii. From 8/20/2015 to 7/17/2018 [redacted]

iii. From 11/11/2013 to present [redacted]

iv. From 11/20/2019 to present [redacted]

e. Applying each Plaintiff State's maximum allowable statutory penalty to estimated violations in each state results in a penalty of [redacted]

f. To deter Google from continuing its misconduct, the penalty must eliminate Google's financial incentive to engage in the misconduct. At minimum, this would involve penalizing Google for the total incremental benefits (including future benefits) from the alleged misconduct.

i. The alleged misconduct provides Google with direct and indirect financial benefits.

ii. I am unable to determine Google's total incremental benefits from the misconduct because Google has not produced information sufficient to determine even the direct benefits from the alleged misconduct, much less the indirect benefits from the alleged misconduct. Additionally, the benefits from both the alleged deceptive trade practices misconduct and the separate antirust conduct alleged in this case play a role within an overall scheme to dominate the display advertising industry.

iii. [redacted] are insufficient and inappropriate to deter future misconduct.

g. Google has paid numerous fines and entered into several settlements related to past misconduct or alleged misconduct. These fines and settlements have not deterred Google from continuing to engage in misconduct.

h. Based on my analysis of the three factors I have considered, the trier of fact should consider a penalty range of [redacted]. However, to the extent the trier of fact considers the additional relevant factors, revisions to this per violation amount may be appropriate. Given this range of penalty per violation and my violation counts, the total penalties related to each misconduct for their respective periods and associated with the Plaintiff States are as follows:

   i. RPO – between $2.06 and $6.16 billion
   ii. DRS – between $1.18 and $3.53 billion
   iii. Bernanke – between $7.27 and $21.81 billion
   iv. Equal Footing on AdX – between $4.75 and $14.24 billion

   If the trier of fact finds that Google is liable for all four of the above misconducts and adopts my violation counts and penalties, the maximum penalty is $21.81 billion as this figure is based on all Open Auctions during the longest period of misconduct. My analysis allows for flexibility to allow the trier of fact to determine penalties regardless of the combination of periods, Plaintiff States, or conducts for which they find Google liable in this matter.

i. Google can pay a penalty as high as $29.08 billion without impacting its day-to-day operations or bankrupting the company.

III. BACKGROUND

A. Google

12. Founded in 1998, Google is a Delaware limited liability company with its principal place of business in Mountain View, California.[6] Google has operated as a wholly owned subsidiary of Alphabet Inc. since 2015.[7] Google states that "[Their] mission is to organize the world's information and make it universally accessible and useful."[8] Initially started as a search engine, Google's offerings now include a wide range of products and services including search, advertising, browsers, web-based services, mobile devices and software, entertainment, analytics, artificial intelligence, and cloud, among others, with user numbers in the billions.[9] As of 2023, Google is the world's dominant search engine, with over 90% global market share and trillions of searches each year.[10] Google's sites generate approximately 277 million unique visitors per day in the United States alone.[11]

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[6] "Our Story," available at **https://about.google/intl/ALL_us/our-story/, accessed 12/29/2023**. As I discuss above, Google refers to Google, LLC, formerly known as Google, Inc., and a subsidiary of the holding company, Alphabet, Inc. Throughout this report I rely on the financial statements and share prices of the reporting entities – Google, Inc. or Alphabet, Inc.

[7] "Google Establishes Alphabet Holding Company," Wall Street Journal, October 2, 2015, available at **https://www.wsj.com/articles/google-to-establish-alphabet-holding-company-after-close-of-trading-friday-1443801447, accessed 12/29/2023.**

[8] "About Google," available at **https://about.google/intl/ALL_us/, accessed 12/29/2023;** Alphabet Inc. Form 10-K for the fiscal year ended December 31, 2022, p. 4.

[9] "Google turns 20: how an internet search engine reshaped the world," The Verge, September 17, 2018, available at **https://www.theverge.com/2018/9/5/17823490/google-20th-birthday-anniversary-history-milestones, accessed 12/29/2023**; Alphabet Inc. Form 10-K for the fiscal year ended December 31, 2022, pp. 4-6; "Thank you for 25 years of curiosity," available at **https://blog.google/inside-google/company-announcements/google-25th-birthday/, accessed 1/2/2024.**

[10] "Search Engine Market Share Worldwide Jan – Dec 2023," StatCounter, available at **https://gs.statcounter.com/search-engine-market-share/all/worldwide/2023**, accessed 1/10/2024; Alphabet Inc. Form 10-K for the fiscal year ended December 31, 2022, p. 4.

[11] Top 50 Multi-Platform Properties (Desktop, Mobile, and Social), Comscore Media Metrix Multi-Platform, available at **https://www.comscore.com/Insights/Rankings?country=US**, accessed 1/8/2024.

13. Until the company's restructuring in 2015, Google operated as a single segment and reported the entirety of its revenues as Google operations.[12] Starting in 2015, Google began reporting two operating segments – the "Google Segment" and "Other Bets." Finally, from 2020 onwards,[13] Google further differentiated its Google Segment revenues through its two primary operating segments: i) Google Services and ii) Google Cloud. Google Services consists of advertising, consumer subscriptions (e.g., YouTube TV), platforms (e.g., Google Play), and devices (e.g., the Pixel family of devices).[14] Google Cloud operations include the Google Cloud platform and Google Workspace offerings.[15] In addition, the company reports revenues from certain other businesses under "Other Bets." Revenue from this segment was generated primarily from the sale of healthcare-related services and internet services, which collectively accounted for 0.50% of revenues in 2023.[16]

14. Google's primary source of revenue is advertising, which is included in its Google Services segment. In 2023, Google reported total revenues of over $307 billion, of which $237 billion was from advertising.[17] Google sells advertising space to businesses across Google's own platforms, such as Google Search, Maps, and YouTube, or through third-party partners.[18] Google's advertising technologies then work to show the most relevant ads at the most relevant times to

[12] Google Inc., Form 10-Ks for fiscal years ended December 31, 2009 through December 31, 2015. Google acquired Motorola in Q2 2012 and thus for the year 2013 reported a Google segment and Motorola Mobile segment. Google sold the Motorola business in October 2014. *See* Google Inc. Form 10-K year ended 2012; Google Inc. Form 10-K year ended 2014.

[13] Alphabet Inc. Form 10-K for the fiscal year ended December 31, 2020, p. 33.

[14] Alphabet Inc. Form 10-K for the fiscal year ended December 31, 2023, pp.31-32.

[15] Alphabet Inc. Form 10-K for the fiscal year ended December 31, 2023, p. 32.

[16] Alphabet Inc. Form 10-K for the fiscal year ended December 31, 2023, pp. 32, 35.

[17] Alphabet Inc. Form 10-K for the fiscal year ended December 31, 2023, p. 35. Throughout this report, I use annual income statement data through December 31, 2023, to make comparisons across years and calculate growth rates. I also report Google's Q1 2024 revenues and earnings based on its latest available quarterly filing. Finally, I report balance sheet data as of March 31, 2024, based on Google's latest available quarterly filings. I reserve the right to update my analyses based on updated financial information made available by Google up to and during the time of trial.

[18] Alphabet Inc. Form 10-K for the fiscal year ended December 31, 2023, p. 7; "How our business works," available at **https://about.google/how-our-business-works/**, accessed 1/2/2024.

users based on information from users' Google account (e.g. gender, age, language preference), general location, activity, or other information such as the time of day.[19]

B. Ad Tech

15. "Ad Tech" is shorthand for "advertising technology" and refers broadly to the software, systems, platforms, and tools used by publishers, advertisers, and other parties to buy, sell, and manage digital advertising.[20] Digital advertising refers to marketing through online channels, such as websites and streaming sites, and spans various media formats including text, image, audio, and video.[21] As of 2023, global spending on digital advertising was estimated to top $600 billion (USD), and was projected to approach one trillion (USD) by 2027.[22] The United States is the largest digital advertising market in the world, with estimated 2023 digital ad spending of approximately $225 billion.[23] Digital advertising can be divided into different segments, including search, display, instream video, in-app, social media, and email.[24] Display advertising, the segment at issue in this matter, is a subset of digital advertising and largely consists of the image and based

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[19] Alphabet Inc. Form 10-K for the fiscal year ended December 31, 2023, p. 7; "How our business works," available at **https://about.google/how-our-business-works/**, accessed 1/2/2024; "Ads and Data," Google Safety Center, available at **https://safety.google/privacy/ads-and-data/**, accessed 1/4/2024; Google Ad Center Help, available at **https://support.google.com/My-Ad-Center-Help/answer/12156161**, accessed 1/4/2024.

[20] *What is AdTech? Basics of The Ad Tech Ecosystem Explained*, AdButler Blog (May 5, 2021), **https://www.adbutler.com/blog/article/what-is-ad-tech-the-ad-tech-ecosystem-explained**.

[21] *What is digital advertising? A beginner's* guide, Amazon, **https://advertising.amazon.com/library/guides/what-is-digital-advertising.**

[22] *Digital Advertising in the United States – statistics & facts*, Statista (December 18, 2023), *Digital ad spend worldwide to pass $600 billion this year*, eMarketer (July 14, 2023), **https://www.statista.com/topics/1176/online-advertising/#editorsPicks**; **https://www.emarketer.com/content/digital-ad-spend-worldwide-pass-600-billion-this-year**.

[23] *Internet Advertising Revenue Report*, *Full-year 2023 Results*, PwC (April 2024), **https://s3.amazonaws.com/media.mediapost.com/uploads/IAB_PWC_Internet_Ad_Revenue_2024.pdf**.

[24] "Types of Digital Advertising," IDG Advertising, available at **https://idgadvertising.com/types-of-digital-advertising/**, accessed 5/27/2024.

ads that are displayed on web pages in desktop and mobile browsers.[25] Display advertising in the United States totaled approximately $66 billion in 2023.[26]

16. Participants in online display advertising include website publishers, advertisers, ad networks, and ad exchanges. Publishers own display advertising space.[27] Publishers monetize properties, such as websites and creative content hosted online, by selling display ad space to advertisers.[28] Advertisers purchase display advertising space.[29] The key element in an online display advertising transaction is an "impression." A unique impression is created every time a single internet user visits a web page and views an online display ad. In the fraction of a second it takes for the page to load, that impression can be bought, sold, and filled with an advertisement for that particular user to see.[30] Thus, online display advertising is distinct from print advertising due to the ability of advertisers to micro-target their ads to a particular audience, and the ability of publishers to scale their online ad inventory.

17. In the early days of online display advertising, advertisers could only contract directly with publishers to get their ads placed, much like how the process had been done in print media for years.[31] This changed when the first-ever piece of advertising technology emerged – the "ad server."[32] Publisher ad servers are used by publishers to fill ad slots on a website by matching

[25] "Display Advertising," Jargon Buster IAB UK, available at **https://www.iabuk.com/jargon-buster?op=Apply&title=display,** accessed 5/27/2024.
[26] *Internet Advertising Revenue Report*, *Full-year 2023 Results*, PwC (April 2024), **https://s3.amazonaws.com/media.mediapost.com/uploads/IAB_PWC_Internet_Ad_Revenue_2024.pdf**.
[27] *What is AdTech? Basics of The Ad Tech Ecosystem Explained*, AdButler Blog (May 5, 2021), **https://www.adbutler.com/blog/article/what-is-ad-tech-the-ad-tech-ecosystem-explained**.
[28] *What is AdTech? Basics of The Ad Tech Ecosystem Explained*, AdButler Blog (May 5, 2021), **https://www.adbutler.com/blog/article/what-is-ad-tech-the-ad-tech-ecosystem-explained**.
[29] *What is AdTech? Basics of The Ad Tech Ecosystem Explained*, AdButler Blog (May 5, 2021), **https://www.adbutler.com/blog/article/what-is-ad-tech-the-ad-tech-ecosystem-explained**.
[30] *First-Party Ad Server vs. Third-Party Ad Server,* Playwire, available at **https://www.playwire.com/blog/first-party-ad-server-vs-third-party-ad-server**, accessed 4/22/2024.
[31] The AdTech Book (Clearcode Services S.A., 2023), chapter 3; *Real-Time Bidding Explained – How do ad auctions work?*, Ad Tech Explained (August 22, 2021), https://adtechexplained.com/real-time-bidding-explained/#google_vignette.
[32] The AdTech Book (Clearcode Services S.A., 2023), chapter 3.

ads from direct campaigns, real-time bidding ("RTB") auctions, and other media-buying processes.[33] advertiser ad servers are also used by advertisers to track performance (impressions, clicks, etc.) of online advertising campaigns across all publishers.[34] These respective ad servers, thus, allow publishers to better manage their online ad inventory to maximize their yield, and advertisers to better monitor the effectiveness of their online advertising campaigns.

18. Advertisers also utilize ad buying tools to purchase online ad inventory. These ad buying tools let advertisers "target" their ads by setting decision-engine parameters integral to their unique ad campaigns and automated purchasing decisions (e.g., details about the types of users to target, the bids to submit for various types of ad inventory, etc.).[35] Based on these parameters, the ad buying tool will place bids for the advertiser to purchase impressions.[36] Large advertisers typically utilize a specialized ad buying tool called a demand side platform ("DSP").[37] A DSP is a platform that allows media buyers (advertisers and agencies) to run advertising campaigns and buy

[33] The AdTech Book (Clearcode Services S.A., 2023), chapter 6; "What Are First-Party Ad Servers (Publisher Ad Servers)?, available at **https://www.mobileads.com/blog/ad-server/first-party-ad-server**, accessed 4/22/2024.
[34] The AdTech Book (Clearcode Services S.A., 2023), chapter 6; "What is an Ad Server and How Does It Work," Playwire, available at **https://www.playwire.com/blog/what-is-an-ad-server-and-how-does-it-work**, accessed 4/23/2024.
[35] The AdTech Book (Clearcode Services S.A., 2023), chapter 4; "The Ultimate Guide to AdTech," Hightouch, available at **https://hightouch.com/blog/adtech**, accessed 4/23/2024 .
[36] "The Ultimate Guide to AdTech," Hightouch, available at **https://hightouch.com/blog/adtech**, accessed 4/23/2024.
[37] "The Best Advertising Technology (AdTech) Tools For Ecommerce," Ecommerce Tech, available at **https://ecommercetech.io/categories/advertising-technology**, accessed 4/23/2024. *See also* Deposition of [redacted], March 31, 2021 at 88:6-90:8, 93:19-94:3 ("The vast majority of [DSP customers] were actually agencies acting as an agent on behalf of their large advertisers … Q. Would a very small advertiser ever use a DSP? ... A. In my opinion, they have no reason to. And, you know, like many of these other companies, and probably including Google, won't even return their phone call, right? It just doesn't make sense. It's a high maintenance, you know, salespeople, whatever."); Deposition of [redacted], August 15, 2023 at 169:15-170:25 ("Q: What's the difference between DV360 and Google Display ads? ... A: Typically, different advertisers or different budgets within advertisers. As I said DV 3[60] is for more sophisticated advertisers where they're delegating to the agency. The agency is there to add their own value in terms of the art and science of optimizing for the advertiser's marketing objectives. With GDA, Google Display ads, increasingly, advertisers give more control to Google's systems to - through an automated process to achieve their marketing objectives. So it's machines versus humans. DV 3[60] is still a product for high-end advertisers that have practitioners that are specialists in programmatic advertising, figuring out what ads - what sites to run on, what to bid, how to measure success. GDA is a simpler product that scales to a much wider range of less sophisticated advertisers where -- you know, in oversimplified terms, you give it a bid and a budget and a marketing objective, and it does the rest. .. Q: Do large, sophisticated advertisers use Google Display ads? A: Yes, they use both.")

inventory from various ad exchanges and supply side platforms ("SSP") through one user interface.[38] An SSP is a platform designed to help publishers sell their inventory through multiple demand sources, including ad networks, and in some cases directly to DSPs, in an automated, secure and efficient way.[39] Small advertisers, on the other hand, typically optimize and effectuate their online ad purchases using pared-down analogues of DSPs, called ad networks,[40] generally relying on just one buying tool.[41] Large advertisers may also use ad networks.[42]

19. As most display advertising today is sold via RTB through an ad exchange, it is instructive to consider how this process works. When a user visits a web page with an available ad slot, a publisher ad server is alerted and receives certain information about the user.[43] The publisher ad server checks for any direct ad campaigns matching the user and, if none are identified, offers the impression on an RTB auction through an ad exchange,[44] a platform that facilitates the buying and selling of available impressions between advertisers, who place their bids via DSPs or ad networks, and publishers, who sell their inventory via SSP.[45] The ad exchange makes the impression available to all bidders via a bid request.[46] Demand side sources, including DSPs,

[38] The AdTech Book (Clearcode Services S.A., 2023), chapter 4; "Programmatic Advertising 101: What is a DSP?," Basis Technologies, available at **https://basis.com/blog/programmatic-101-dsps-explained**, accessed 4/23/2024.
[39] The AdTech Book (Clearcode Services S.A., 2023), chapter 4.; "What is a Supply-Side Platform (SSP)? Here's everything you need to know," Amazon Ads, available at **https://advertising.amazon.com/library/guides/supply-side-platform**, accessed 4/23/2024.
[40] Deposition of [redacted], March 31, 2021 at 88:13-90:2 ("networks in general have a very simple UI … where you give us your objective ... and the network does everything automatically for your and you get a good outcome.")
[41] The AdTech Book (Clearcode Services S.A., 2023), chapter 4.
[42] *See, for example,* Deposition of Tim Craycroft, August 15, 2023 at 169:15-170:25.
[43] The AdTech Book (Clearcode Services S.A., 2023), chapter 9.
[44] The AdTech Book (Clearcode Services S.A., 2023), chapter 9.
[45] The AdTech Book (Clearcode Services S.A., 2023), chapter 4; "DSP, SSP, and Ad Exchange: What's the Difference?," Mountain, available at https://mountain.com/blog/dsp-ssp-ad-exchange/, accessed 4/23/2024. Ad exchanges may be combined with SSPs, for example since 2018 Google's AdX (ad exchange) and DFP (SSP) have been combined under Google Ad Manager. *See* "Introducing Google Ad Manager," Google Blog, June 27, 2018, available at **https://blog.google/products/admanager/introducing-google-ad-manager/**, accessed 5/15/2024.
[46] The AdTech Book (Clearcode Services S.A., 2023), chapter 9; "What is a Bid Request and How Does it Work?," Set Up Ad, available at **https://setupad.com/blog/bid-request/**, accessed 4/23/2024.

evaluate the bid request in relation to targeting parameters.[47] A bid is placed, and the ad markup enclosed in a bid response.[48] The ad exchange receives the bids, and the impression generally goes to the highest bidder, with the winner's ad markup being sent to the browser.[49] Typically, the highest bidder pays the price of the second-highest bid, plus an additional small amount (usually $0.01), in what is known as a second-price auction.[50] Ad exchanges charge publishers a share of the transaction value, known as a "take rate," to facilitate the transaction, typically in the range of 10 to 30%.[51] This entire process happens in real time when an ad is loaded onto the page, usually within 100-150 milliseconds.[52] By way of reference, it takes about 300 milliseconds to blink.[53]

20. The flow of display advertising transactions through these platforms is illustrated in **Figure 1**, below.[54]

[47] The AdTech Book (Clearcode Services S.A., 2023), chapter 9; "What is a Bid Request and How Does it Work?," Set Up Ad, available at **https://setupad.com/blog/bid-request/**, accessed 4/23/2024.

[48] The AdTech Book (Clearcode Services S.A., 2023), chapter 9; "What is a Bid Request and How Does it Work?," Set Up Ad, available at **https://setupad.com/blog/bid-request/**, accessed 4/23/2024.

[49] The AdTech Book (Clearcode Services S.A., 2023), chapter 9; "What is a Bid Request and How Does it Work?," Set Up Ad, available at **https://setupad.com/blog/bid-request/**, accessed 4/23/2024. I understand that some bids may be excluded based on criteria set by the publisher. *See* "Protections Overview, Google Ad Manger Help, available at **https://support.google.com/admanager/answer/2913553**, accessed 5/27/2024.

[50] The AdTech Book (Clearcode Services S.A., 2023), chapter 9. "Second-Price Auction," Smartclip, available at **https://smartclip.tv/adtech-glossary/second-price-auction/**, accessed 4/23/2024; For reference, second-price auctions have long been the industry norm in programmatic advertising. However, Google transitions to a first-price auction model in 2019. [*Why Google Switched to First Price Auction? Insider's Insight*, AdPushup (June 25, 2023), **https://www.adpushup.com/blog/first-price-auction/#:~:text=6%20Mins%20Read,industry%20norm%20in%20programmatic%20advertising**. *See also,* Expert Report of Dr. Matthew Weinberg, Section 2.A.1, June 7, 2024.

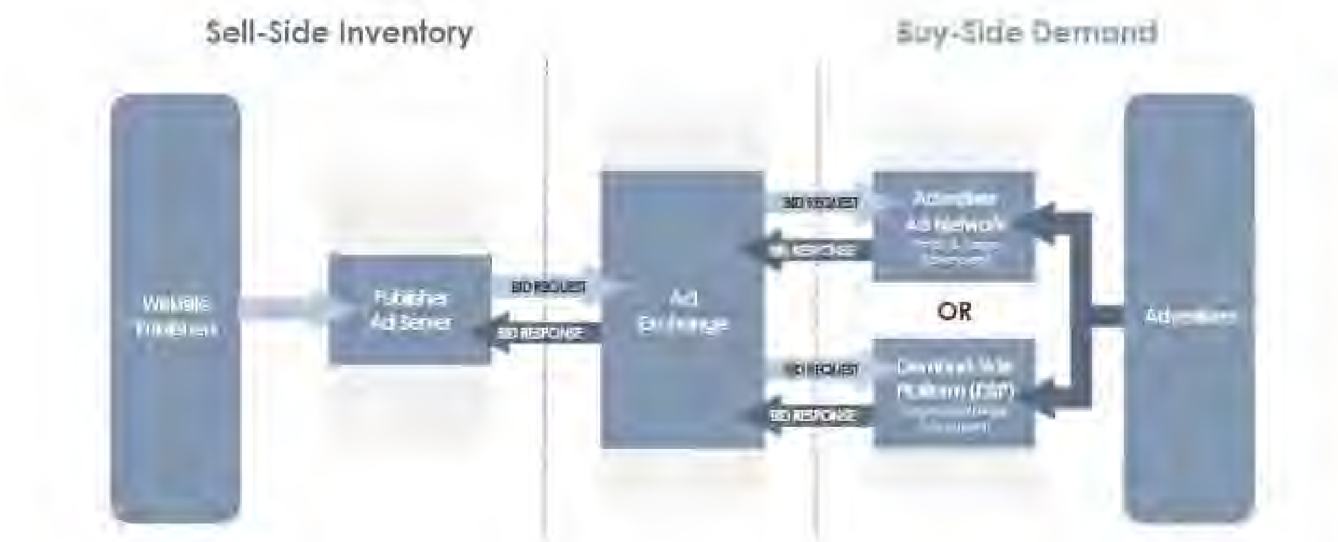
[51] "The Best Ad Exchanges for Publishers," Publisher Growth, available at **https://publishergrowth.com/category/platform/ad-exchanges**, accessed 5/27/2024.

[52] The AdTech Book (Clearcode Services S.A., 2023), chapter 9; "What is Programmatic Advertising? A Complete Guide for Agencies," Agency Analytics, available at **https://agencyanalytics.com/blog/what-is-programmatic-advertising**, accessed 4/23/2024.

[53] The AdTech Book (Clearcode Services S.A., 2023), chapter 9.

[54] DOJ Complaint at ¶53, Figure 3.

Figure 1



C. The Evolution of Google's Role in the Ad Tech Space

21. Google entered the display advertising industry in the early 2000s when it launched AdSense, enabling publishers to display AdWords ads on their own websites.[55] In 2005, Google then introduced site targeting to AdWords, which gave advertisers the ability to "target their ads to thousands of specific content sites across the Google Network,"[56] enabling "AdWords advertisers and AdSense publishers [to] connect in a way not previously possible."[57]

22. By the mid-2000's, Google recognized that publisher ad servers set the rules for how and to whom ad spaces are sold.[58] Accordingly, Google developed its own publisher ad server.[59] When Google's publisher ad server failed to gain traction in the ad serving market, the company pivoted in 2008 to acquire their market-leading competitor DoubleClick in a deal valued

[55] *The History of Google Ads 20 Years in the Making*, **https://instapage.com/blog/google-adwords-infographic/.**
[56] "Site Targeting," Google Blog, April 25, 2005, available at **https://googlepress.blogspot.com/2005/04/site-targeting_25.html**, accessed 5/27/2024; "Site targeting: a refresher," Google Blog, December 30. 2005, available at **https://adsense.googleblog.com/2005/12/site-targeting-refresher.html**, accessed 5/27/2024.
[57] "Site targeting: a refresher," Google Blog, December 30. 2005, available at **https://adsense.googleblog.com/2005/12/site-targeting-refresher.html**, accessed 5/27/2024.
[58] *How Three Mergers Buttressed Google's Ad Tech Monopoly, Per DOJ*, Tech Policy Press (March 9, 2023), **https://www.techpolicy.press/how-three-mergers-buttressed-googles-ad-tech-monopoly-per-doj/**.
[59] *How Three Mergers Buttressed Google's Ad Tech Monopoly, Per DOJ*, Tech Policy Press (March 9, 2023), **https://www.techpolicy.press/how-three-mergers-buttressed-googles-ad-tech-monopoly-per-doj/**.

at $3 billion.[60] DoubleClick operated the industry-leading publisher ad server, DoubleClick for Publishers ("DFP").[61] Upon combining DoubleClick with Google's nascent publisher ad server, Google was estimated to control approximately 60% of the publisher ad server market in 2008.[62] Since then, [redacted][63]

23. When Google purchased DoubleClick, it also acquired the company's up-and-coming ad exchange technology, DoubleClick Ad Exchange.[64] In 2009, Google announced the DoubleClick Ad Exchange (now known as Google Ad Exchange or "AdX"), describing it as "a real-time marketplace that helps large online publishers on one side; and ad networks and agency networks on the other, buy and sell display advertising space."[65] Today AdX is estimated to account for at least 50% of the ad exchange market.[66]

24. In 2010, Google then acquired Invite Media for approximately $81 million.[67] Invite Media was an ad buying tool designed for large advertisers, allowing them to buy ad space on multiple ad networks at the same time.[68] At the time, Google had been working on developing its

[60] *How Three Mergers Buttressed Google's Ad Tech Monopoly, Per DOJ*, Tech Policy Press (March 9, 2023), **https://www.techpolicy.press/how-three-mergers-buttressed-googles-ad-tech-monopoly-per-doj/**.
[61] *DOJ's Ad Tech Antitrust Case Against Google: A Brief Overview*, Congressional Research Service Legal Sidebar (May 5, 2023), **https://crsreports.congress.gov/product/pdf/LSB/LSB10956.**
[62] *How Three Mergers Buttressed Google's Ad Tech Monopoly, Per DOJ*, Tech Policy Press (March 9, 2023), **https://www.techpolicy.press/how-three-mergers-buttressed-googles-ad-tech-monopoly-per-doj/**.
[63] *See* Expert Report of Dr. Joshua Gans, June 7, 2024, Section VI.C.
[64] "Google Buys DoubleClick for $3.1 Billion," New York Times, April 14, 2007. .
[65] "The DoubleClick Ad Exchange: growing the display advertising pie for everyone," Google Blog, September 17, 2009, available at **https://googleblog.blogspot.com/2009/09/doubleclick-ad-exchange-growing-display.html**, accessed 5/27/2024.
[66] *How Three Mergers Buttressed Google's Ad Tech Monopoly, Per DOJ*, Tech Policy Press (March 9, 2023), **https://www.techpolicy.press/how-three-mergers-buttressed-googles-ad-tech-monopoly-per-doj/**. *See also* Expert Report of Dr. Joshua Gans, June 7, 2024, Section V.D, IX.C.
[67] *How Three Mergers Buttressed Google's Ad Tech Monopoly, Per DOJ*, Tech Policy Press (March 9, 2023), **https://www.techpolicy.press/how-three-mergers-buttressed-googles-ad-tech-monopoly-per-doj/**.
[68] *How Three Mergers Buttressed Google's Ad Tech Monopoly, Per DOJ*, Tech Policy Press (March 9, 2023), **https://www.techpolicy.press/how-three-mergers-buttressed-googles-ad-tech-monopoly-per-doj/**.

DV360 tool provide the same service.[69] Today DV360, Google's DSP, is the largest platform for agencies and big advertisers with an estimated 40% market share as to large advertiser buying tools.[70] Google Ads (formerly AdWords) is now the company's advertiser ad network, used mostly by small brands, and has at least a 50% market share as to small advertiser buying tools.[71]

25. In 2011, Google acquired AdMeld for approximately $400 million.[72] AdMeld's technology helped big publishers compare and identify the best ad prices that advertisers were offering on ad exchanges competing with Google.[73] This technology was known as "yield management" or "yield optimization," and represented a threat to Google's ad exchange and publisher ad server dominance.

26. Over the last fifteen years Google has grown their sell-side (publisher), buy-side (advertiser), and ad exchange market shares, to the point where today the company has a significant presence in all parts of Ad Tech.[74]

27. The total percentage of advertiser spend extracted by ad tech intermediaries has a substantial impact on the revenues earned by publishers and the return on investment to advertisers. According to Google's internal documents, [redacted][75]

[69] *How Three Mergers Buttressed Google's Ad Tech Monopoly, Per DOJ*, Tech Policy Press (March 9, 2023), **https://www.techpolicy.press/how-three-mergers-buttressed-googles-ad-tech-monopoly-per-doj/**.
[70] *How Three Mergers Buttressed Google's Ad Tech Monopoly, Per DOJ*, Tech Policy Press (March 9, 2023), **https://www.techpolicy.press/how-three-mergers-buttressed-googles-ad-tech-monopoly-per-doj/**.
[71] *How Three Mergers Buttressed Google's Ad Tech Monopoly, Per DOJ*, Tech Policy Press (March 9, 2023), **https://www.techpolicy.press/how-three-mergers-buttressed-googles-ad-tech-monopoly-per-doj/**. *See also* Expert Report of Dr. Joshua Gans, June 7, 2024, Section V.E.
[72] *How Three Mergers Buttressed Google's Ad Tech Monopoly, Per DOJ*, Tech Policy Press (March 9, 2023), **https://www.techpolicy.press/how-three-mergers-buttressed-googles-ad-tech-monopoly-per-doj/**.
[73] *How Three Mergers Buttressed Google's Ad Tech Monopoly, Per DOJ*, Tech Policy Press (March 9, 2023), **https://www.techpolicy.press/how-three-mergers-buttressed-googles-ad-tech-monopoly-per-doj/**.
[74] DOJ Complaint at ¶75, Figure 5.
[75] [redacted]

Figure 2

[redacted]

D. Summaries of Auction Manipulations and Alleged Misconduct

28. I understand that the Plaintiff States allege that many of Google's acts, practices, misrepresentations, and omissions from 2013 to the present are unfair, deceptive, false, and/or misleading, and/or have the capacity or tendency to deceive or are likely to deceive. I further understand that Dr. Matthew Weinberg and Dr. Joshua Gans provided expert reports on behalf of the Plaintiff States, which analyze and offer opinions regarding the operation, impact, harm, and misleading and deceptive acts and practices related to Google's conduct and auction manipulations, including Reserve Price Optimization, Dynamic Revenue Sharing, and Project Bernanke, as well as Header Bidding, and the Network Bidding Agreement between Facebook and Google. I have reviewed and rely upon these reports, and nothing herein is intended to refute or dispute those opinions. For context, I provide a brief summary below of my understanding of Google's auction manipulations and the alleged misconduct based primarily on my review and

reliance on documents produced in this lawsuit, as well as the expert reports of Professors Weinberg and Gans.

29. As a preliminary matter, however, I understand that, starting at least as early as 2010 and running through September 2019, Google represented to both publishers and advertisers that AdX was operated as a second-price auction.[76] Auction participants based their strategies and evaluated the outcome of auctions believing that Google's representation was true. For example, a second-price auction structure incentivizes buyers to bid their "true value," which is the maximum amount a buyer is willing to pay for an impression.[77] However, through various Google programs implemented starting in at least 2013, I understand that Google manipulated the auction process such that AdX auctions could no longer be characterized as they were represented, including through RPO, DRS, and Project Bernanke and their various iterations. Further, I understand that Google made misrepresentations and concealed important information related to this conduct, even concealing some of these programs entirely, thus misleading and deceiving

[76] *See, e.g.,* GOOG-DOJ-29803801 at -804 (March 2016 RPO Brief states under external verbal talking points "The AdX Auction model is 2nd price, as described in Help Center"); "Google's Scott Spencer On DoubleClick Ad Exchange Auction And Data Management," ad exchanger, February 9, 2010, available at **https://www.adexchanger.com/ad-exchange-news/googles-scott-spencer-on-doubleclick-ad-exchange-auction-and-data-management/**, accessed 4/19/2024 ("AdX is a second price auction with minimum CPMs set by the publisher."); GOOG-NE-06567486 at -490 (Master Press document "Ad Exchange uses a second price auction model"); GOOG-NE-13340735 [redacted] Declaration of [redacted], August 5, 2023 at ¶ 24 ("In a second-price auction, advertisers are incentivized to bid an amount equivalent to the actual value they place on an impression because they will only need to pay the amount of the second-highest bid if they win."); "Rolling out first price auctions to Google Ad Manager partners," Google Ad Manager, September 5, 2019, available at **https://blog.google/products/admanager/rolling-out-first-price-auctions-google-ad-manager-partners**, accessed 4/19/2024/. *See also* Expert Report of Dr. John Chandler, June 7, 2024, §X.C,G.

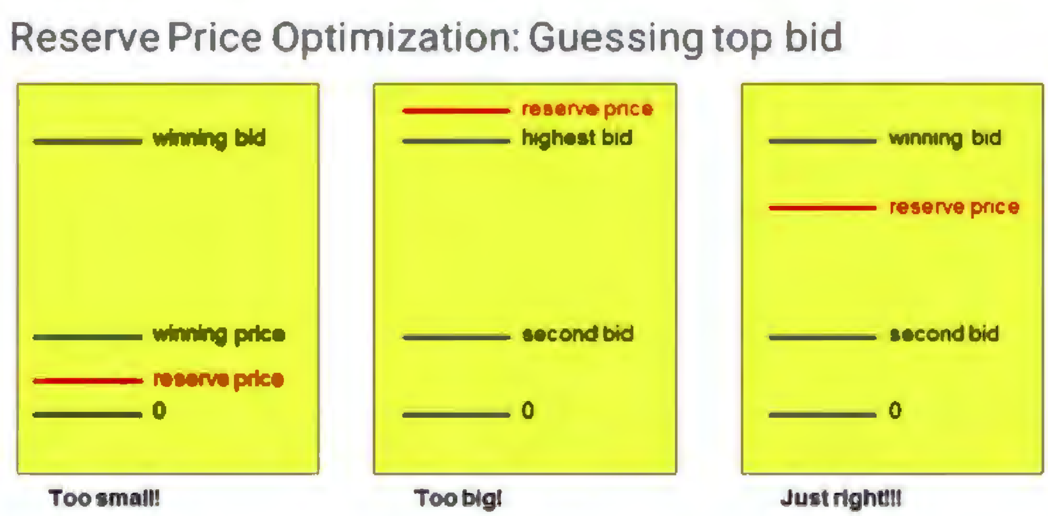
[77] *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 9; GOOG-AT-MDL-B-002086688 ("Now second price auctions have various theorems that (non-colluding) actors have optimal strategies to bid their true value."); "Google's Scott Spencer On DoubleClick Ad Exchange Auction And Data Management," ad exchanger, February 9, 2010, available at **https://www.adexchanger.com/ad-exchange-news/googles-scott-spencer-on-doubleclick-ad-exchange-auction-and-data-management/**, accessed 4/19/2024 ("…incentivizes buyers to bid the most that they're willing to pay for a given piece of inventory and it minimizes the need to 'game' the system."). S*ee also* Expert Report of Dr. John Chandler, June 7, 2024, §VI,D.

auction participants and causing them to behave differently than they would have but for Google's misconduct.

i. Reserve Price Optimization

30. I understand that with Reserve Price Optimization ("RPO"), Google used buyer's historical bidding information and other transaction data prior to seeing live bids in order to determine a reserve price that Google believed would optimize AdX revenue, and that Google then used this artificial reserve price in AdX instead of the reserve price set by the publisher, thus overriding the reserve price that had been set by the publisher.[78] In addition, RPO was used to set the reserve price just below the highest bidder's true value, or "as close to the anticipated first price as possible in order to trade buyer for seller surplus."[79] This phenomenon is illustrated in **Figure 3**, below.[80]

Figure 3



[78] *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 9. *See also*, GOOG-NE-04719370; GOOG-AT-MDL-004408571 at -573; GOOG-NE-06842715 at -718.
[79] *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 9.
[80] GOOG-NE-13202730 at -739.

31. I also understand that while RPO was launched in phases between March/April and October 2015,[81] Google did not announce this program to its customers prior to its launch.[82] In fact, Google did not announce the program until May 12, 2016, over a year after its initial rollout, which it announced in a blog post under the name "optimized pricing."[83] At that time, publishers could not opt out of RPO.[84] [redacted]."[85] In any event, on or about September 25, 2019, Google publicly migrated to a first-price auction format on AdX, thus effectively ending the RPO program in what Google had represented to be a second price auction.[86]

32. I also understand that Google concealed material information from publishers and advertisers during the period RPO was concealed, and intended to communicate about the program only if it was noticed externally. For example, a March 2015 internal email states, "We do not plan to announce anything externally for now, and the affected commercialization teams are ready with a PR approved reactive message when someone notices."[87] Another March 2015 internal email states, "when it [RPO] is noticed externally (likely), we use the non-specific language in the

[81] *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 9; Defendant Google LLC's First Amended Responses and Objections to Plaintiffs' Third Set of Interrogatories, Responses to Interrogatory No. 6; GOOD-AT-MDL-003996097; GOOG-DOJ-29803801; GOOG-AT-MDL-004408571 at -572; GOOG-DOJ-15428245 at -246; GOOG-DOJ-15435288 at -289.
[82] *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 9.
[83] *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 9. *See also,* Google Ad Manager "Smarter optimizations to support a healthier programmatic market," May 12, 2016, available at https://blog.google/products/admanager/smarter-optimizations-to-suppor/, accessed 5/26/2024; GOOG-AT-MDL-001391101; GOOG-AT-MDL-004408571 at -572.
[84] *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 9; GOOG-NE-06842715 at -718.
[85] *See* GOOG-DOJ-15418450; GOOG-AT-MDL-B-001109245. *See also,* Expert Report of Dr. John Chandler, June 7, 2024, §X.G.
[86] GOOG-DOJ-AT-02202934; "Rolling out first price auctions to Google Ad Manager partners," Google Ad Manager, September 5, 2019, available at **https://blog.google/products/admanager/rolling-out-first-price-auctions-google-ad-manager-partners**, accessed 4/19/2024. *See also* Defendant Google LLC's First Amended Responses and Objections to Plaintiffs' Third Set of Interrogatories, Responses to Interrogatory No. 6.
[87] GOOG-NE-06591119.

comms doc (we don't say we are optimizing reserves specifically)."[88] Internally, Google considered randomizing RPO price floors to "limit attention."[89]

33. I further understand that RPO impacted both publishers and advertisers because it led to lower payoff to advertisers and it could prevent publishers from effectively optimizing revenue, and that such negative impacts partially stem from Google's concealment of RPO.[90]

34. In addition, I understand that both before and after RPO was announced as optimized pricing, RPO impacted publisher behavior.[91] For example, by concealing RPO, Google prevented publishers from effectively optimizing revenue, and even after it was disclosed, publishers might set suboptimal reserves on any impression for which RPO may have been active.[92] I also understand that some publishers might prefer outcomes without RPO than with RPO.[93]

35. Google also impacted advertiser behavior through its second-price auction representation and concealment of RPO. Namely, I understand that Google's representation that it was running a second-price auction encouraged advertisers to bid their true value for impressions, which over time caused later AdX reserve prices to increase,[94] which, in turn, led to a payoff loss for advertisers by decreasing win rates and increasing the average clearing price in later AdX auctions.[95]

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[88] GOOG-AT-MDL-014566000. *See also* GOOG-NE-12737317 ("comms strategy is not to discuss Dynamic RPO in-detail comms forum… This is INTERNAL ONLY as well"); GOOG-AT-MDL-015109224 ("pubs don't know about RPO").
[89] GOOG-AT-MDL-017664768.
[90] *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 9.A.1.
[91] *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 9.A.1.
[92] *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 9.A.1.
[93] *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 9.A.1.
[94] As Dr. Weinberg opines, if advertisers had been aware of RPO, they could have improved their gains over time by shading their bids from the beginning.
[95] *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 9.B. Dr. Weinberg opines that RPO's effect on AdX is ambiguous because it both decreases the AdX win rate and increases the average AdX clearing price. However, Dr. Weinberg concludes that the gains from the increase in average price likely outweigh the losses from a decreased win rate as Google is a sophisticated actor.

ii. Dynamic Revenue Sharing

36. I understand that with Dynamic Revenue Share ("DRS"), Google manipulated its AdX take rate to win impressions it otherwise would have lost but-for DRS.[96] Prior to DRS, AdX imposed a 20% take rate on winning advertisers bids submitted through AdX.[97] Through DRS, Google adjusted its 20% take rate to win impressions.

37. I also understand that Google ran three versions of the DRS program – DRSv1, DRSv2, and tDRS.[98] In August of 2015, Google fully launched an initial version of DRS—DRSv1—without announcing it to publishers and advertisers, and opted all publishers into the program without their knowledge.[99] [redacted],[100] and as early as September 2014, internal teams at Google had agreed to launch DRS as a "silent launch."[101]

38. With DRSv1, Google allowed for the DRS program to lower AdX's take rate below 20% after soliciting and "peeking" at bids in order to win an impression.[102] This phenomenon is illustrated in **Figure 4**, below.[103] I also understand that with DRSv1, AdX did not run a true second price auction.[104]

[96] *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 7.E. S*ee also,* GOOG-AT-MDL-014568201; GOOG-DOJ-AT-02423615.
[97] *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 7. See also, GOOG–DOJ–14265301.
[98] *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 7 A-C.
[99] *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 7.A. S*ee also,* GOOG-TEX-00777528 at -530; GOOG-NE-09485306 at -5453; GOOG-AT-MDL-B-004435235 at 309; GOOG-DOJ-14368357 at 357; Defendant Google LLC's First Amended Responses and Objections to Plaintiffs' Third Set of Interrogatories, Responses to Interrogatory No. 6.
[100] *See* Expert Report of Dr. John Chandler, June 7, 2024, §X.F, G.
[101] GOOG-DOJ-14265301.
[102] *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 7.A. *See also,* GOOG-AT-MDL-014568201; GOOG-DOJ-AT-02423615.
[103] GOOG-NE-13204982 at -983.
[104] *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 7.A.

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Figure 4

39. I also understand that in a subsequent iteration of DRS launched in December 2016—referred to as DRSv2—AdX would either decrease AdX's take rate below 20% or increase AdX's take rate above 20% to win impressions it would not have won if the take rate were 20%, depending on various factors.[105] Google announced DRSv2 (under a different name) when it was launched and allowed publishers to opt out of the program (if a publisher opted out, DRSv1 was turned off as well), but advertisers and ad buying tools could not.[106] I also understand that DRSv2 tracked "debts" incurred by publishers and advertisers, and that a publisher could see decreased revenues through DRSv2.[107]

40. A third iteration of DRS, tDRS, was implemented in July 2018 (after Google ran experiments in 2017) and replaced DRSv2.[108] The "t" in tDRS stands for "truthful." I understand

[105] GOOG-AT-MDL-B-004377628 at -759 and -761; Defendant Google LLC's First Amended Responses and Objections to Plaintiffs' Third Set of Interrogatories, Responses to Interrogatory No. 6; GOOG-AT-MDL-001004706 at -743; GOOG-NE-09485306 at -405; GOOG-AT-MDL-008842393 at -403.
[106] *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 7.B.
[107] *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 7.B.
[108] *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 7.C; Google's First Amended Responses and Objections to Plaintiffs' Third Set of Interrogatories, Response to Interrogatory No. 6; GOOG-DOJ-13949282 at tab "Q3Q4 2018" row 7.

the program was revised to adjust the AdX take rate based on a predictive model instead of "peeking" at actual bids and adjusting the revenue share thereafter.[109] tDRS was in place from July 2018 until late 2019, when Google shifted to a first price auction format in AdX.[110]

41. It is my understanding that Google concealed material information from publishers and advertisers by not disclosing DRSv1, which negatively impacted them and prevented them from employing optimal strategies.[111] For example, I understand that but for Google's omissions, publishers who believed that AdX ran a standard second price auction would have set different reserve prices if they had been aware of DRSv1.[112] Moreover, I understand that by not revealing DRSv1 and leading advertisers to believe the AdX auction was a standard second-price auction, advertisers would engage in suboptimal behavior.[113] For example, if advertisers had known of DRSv1, they could shade their bids to get a higher return.[114]

42. The same is true of DRSv2. I understand that some aspects of DRSv2 were misleading to advertisers and publishers based, in part, on Google's omissions in clearly disclosing the concept of debt with DRSv2, which mislead both advertisers and publishers regarding how much they are paying or paid out, prevented them from employing optimal bidding strategies, and

[109] *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 7.C; GOOG-DOJ-AT-02423615.
[110] *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 7.C; Defendant Google LLC's First Amended Responses and Objections to Plaintiffs' Third Set of Interrogatories, Responses to Interrogatory No. 6; GOOG-DOJ-15130321; GOOG-DOJ-AT-01509153; GOOG-DOJ-AT-01516187 at -205; "Rolling out first price auctions to Google Ad Manager partners," Google Ad Manager, September 5, 2019, available at https://blog.google/products/admanager/rolling-out-first-price-auctions-google-ad-manager-partners, accessed 4/19/2024.
[111] *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 7.D.1; Section 7.F.2.
[112] *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 7.D.1.
[113] *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 7.F.2.
[114] *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 7.F.2.

obscured feedback to advertisers.[115] I also understand that certain aspects of tDRS were misleading to publishers.[116]

iii. Project Bernanke

43. I understand that Project Bernanke and its subsequent iterations, Global Bernanke and First Price Bernanke, facilitated both the effects of collusion among Google Display Network ("GDN") advertisers without their knowledge, as well as overbidding (bidding above one's" true value") in auctions.[117] I also understand that Google never disclosed Project Bernanke or its progeny to publishers or advertisers,[118] and that Google ran ongoing Bernanke experiments on live auctions while concealing the program.[119] Indeed, internal Google documents refer to Project Bernanke as [redacted]"[121]

44. Google launched Project Bernanke November 2013.[122] I understand that Project Bernanke manipulates the highest and second highest GDN bids before sending them to the AdX auction, and that under Project Bernanke, Google created a "pool" for each publisher (about which, I understand publishers were unaware)[123] that was added to or taken from depending on whether

[115] *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 7.G. Moreover, one internal Google document advocating for tDRS states that [redacted].
[116] *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 7.G.
[117] *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 8.
[118] GOOG-AT-MDL-006218271 at -287; Letter from Freshfields Bruckhaus, Deringer US LLP dated May 24, 2024 "Re: State of Texas et al. v. Google LLC, No. 4:20-cv-957-SDJ (E.D. Tex.)," p. 8.
[119] *See* Expert Report of Dr. John Chandler, June 7, 2024, §X.G.
[120] GOOG-NE-10929507, at -507, -514, -515.
[121] GOOG-DOJ-15445619.
[122] GOOG-DOJ-28386151 at -165; GOOG-DOJ-03875910; GOOG-DOJ-AT-01130405; Defendant Google LLC's First Amended Responses and Objections to Plaintiffs' Third Set of Interrogatories, Responses to Interrogatory No. 6.
[123] *See* Expert Report of Dr. Joshua Gans, June 7, 2024, Section VIII.B.

GDN's take rate exceeded or fell below a certain percentage.[124] In August 2015, Google launched Global Bernanke, which I understand maintained a single pool for all publishers across AdX.[125]

45. I also understand that under Projects Bernanke and Global Bernanke, individual publisher revenues could decrease, and both iterations could lead to a reduction in ad quality and revenue per mille for publishers.[126] In addition, I understand that Projects Bernanke and Global Bernanke overcharged advertisers[127] and would decrease the win rate of non-GDN advertisers.[128]

46. I also understand that Google concealed material information from publishers and advertisers by concealing Projects Bernanke and Global Bernanke. For example, all publishers likely would have changed their behavior had they known about Projects Bernanke and Global Bernanke by raising their reserve prices in order to maximize their revenue.[129] Moreover, I understand that because Google never disclosed Projects Bernanke and Global Bernanke to advertisers, advertisers thought they were participating in a true second price auction and bid their true value, but they would have shaded their bids in order to get higher payoffs had they known about Projects Bernanke and Global Bernanke.[130]

47. On or about October 25, 2019, after Google transitioned to a first price auction, Google launched an updated version of Project Bernanke, sometimes called "Alchemist," but referred to herein as "First Price Bernanke."[131] Under First Price Bernanke, I understand that GDN

[124] *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 8.A.
[125] Defendant Google LLC's First Amended Responses and Objections to Plaintiffs' Third Set of Interrogatories, p. 13. I understand Global Bernanke had certain per publisher requirements related to margin and publisher revenue. *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 8.B.
[126] *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 8.C.1, Section 8.C.2.
[127] *See* Expert Report of Dr. Joshua Gans, June 7, 2024, Section VIII.B.
[128] *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 8.E.1.
[129] *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 8.C.3.
[130] *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 8.E.2.
[131] GOOG-DOJ-AT-02224828 at -828; Defendant Google LLC's First Amended Responses and Objections to Plaintiffs' Third Set of Interrogatories, Responses to Interrogatory No. 6. *See also* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 8.G referring to this version of Bernanke as "First-Price Project Bernanke."

continued to manipulate advertisers' bids before sending them to AdX, by implementing either collusion (which led to submitting lower bids) or overbidding (which led to submitting higher bids) amongst advertisers.[132] Collusion allowed for more aggressive bid-shading and increased GDN's payoff at the expense of publishers' revenue, while overbidding increased publishers' revenue at the expense of non-GDN advertisers.[133] Each aspect changed AdX's clearing price. I understand that First Price Bernanke still operates today.[134]

iv. Header Bidding

48. I understand that Header Bidding is a real time bidding technology that was developed as a reaction to the inefficiencies of waterfalling,[135] a process used by ad servers to sell an impression,[136] and to circumvent Google's ad exchange.[137] I also understand that Google was aware of Header Bidding's positive impact on publishers. For example, internal Google communications acknowledge that Header Bidding is "[g]ood for" publishers because it permits "universal competition with real-time pricing,"[138] that "[p]ublishers are likely fine with header bidding," because "they make more money with it."[139] I also understand that Google recognized the competitive threat that Header Bidding posed to AdX.[140] For example, an internal Google document states that one of its priorities was [redacted]

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[132] *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 8.G.
[133] *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 8.G.
[134] Complaint at ¶589.
[135] Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 3.B; GOOG-NE-10780865.
[136] Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 3.B.
[137] *See also* Expert Report of Dr. Joshua Gans, June 7, 2024, Section III.D. *See also,* "Header Bidding 101," Forbes, March 2, 2022, available at **https://www.forbes.com/sites/forbesbusinesscouncil/2022/03/02/header-bidding-101/?sh=1304d401a970**, accessed 3/15/2024.
[138] GOOG-AT-MDL-001110980 at -997.
[139] GOOG-NE-12787680.
[140] Expert Report of Dr. Joshua Gans, June 7, 2024, Section VII.B.

Bidding,"[141] and another shows that Google initiated an internal project called "Header Bidding Observatory" to monitor and counter what it called the "largest competitive threat to AdX."[142]

49. Accordingly, I understand that Google undertook various efforts to respond to and suppress the competitive threat of Header Bidding, [redacted],[143] by restricting publisher use of line items in publisher ad server settings, redacting key data fields from AdX databases provided to publishers, and entering into the Facebook Network Bidding Agreement to prevent Facebook's investment in Header Bidding technology.[144] I further understand that Google's Exchange Bidding, whereby third-party exchanges could bid in auctions against AdX, was another response to the competitive threat of Header Bidding.[145]

50. I understand that Header Bidding improves publisher revenue, including as compared to Google's Exchange Bidding, and thus, suppression of Header Bidding negatively impacts publishers.[146]

v. Equal Footing Misrepresentation

51. I understand that since at least 2019,[147] Google has publicly represented that it ran a transparent auction where all bidders on Google's ad exchange competed on equal footing. For example, a Google blog from March 2019 on first price auctions for Google Ad Manager noted

[141] GOOG-NE-04421287.
[142] GOOG-TEX-00635680 at -681.
[143] GOOG-TEX-00036144 at -146-147.
[144] *See* Expert Report of Dr. Joshua Gans, June 7, 2024, Section IX.B. Dr. Gans also opines that Google's implementation of Unified Pricing Rules interfered with publishers' use of Header Bidding.
[145] *See* Expert Report of Dr. Joshua Gans, June 7, 2024 Section IX.B.
[146] *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 5.B.
[147] Google document indicate that this representation was made before 2019 as well, including as early as 2017. See GOOG-DOJ-13899276 (Internal Google documents showing representation was shared with "partner exchanges" as early as March 2017); *see also* GOOG-AT-MDL-B-002019839 at -842 (Email from Google to a media company dated January 3, 2018) and GOOG-AT-MDL-001163787 (Email from Google to authorized buyers re: "Auction Dynamics Clarification" dated April 3, 2019).

that Google was creating a "fair and transparent market for everyone."[148] Additionally, Google's webpage from at least November of 2019 explains how open bidding works, and represents that "[a]ll participants in the unified auction, including Authorized Buyers and third-party yield partners, compete equally for each impression on a net basis."[149]

52. I further understand that Google's representations that it ran a transparent auction where participants were allegedly on equal footing were false, misleading, and deceptive due to various auction manipulations, including Project Bernanke, as well as Google's preferential treatment of Facebook through the Google/Facebook Network Bidding Agreement ("NBA").

53. I understand that on September 28, 2018, Google entered into the NBA with Facebook to allow the Facebook Audience Network ("FAN") to participate in Google's new exchange bidding service, and from Google's perspective, to fight off the threat of Header Bidding and FAN.[150] It is also my understanding that as part of the NBA, Google and Facebook agreed to a minimum spend requirement and that the NBA would remain confidential and not be disclosed publicly, which helped Facebook manage its public perception.[151] I understand that the NBA also provided Facebook with numerous other advantages, including a grant of direct remittance (which allowed Facebook to pay publishers directly), a guaranteed match rate and malware identification for Facebook, and granting Facebook access to proprietary Google data.[152] In other words, through the NBA, Google provided Facebook with advantages that were not available to other auction

[148] "Simplifying programmatic: first price auctions for Google Ad Manager," Google Blog, March 6, 2019, available at https://blog.google/products/admanager/simplifying-programmatic-first-price-auctions-google-ad-manager/, accessed 5/7/2024.
[149] "How Open Bidding Works," Google Ad Manager, November 20, 2019, available at https://web.archive.org/web/20191120001210/https:/support.google.com/admanager/answer/7128958, accessed 5/23/2024. Note, this is the earliest available version of this representation on Google's website that I was able to locate.
[150] *See* Expert Report of Dr. Joshua Gans, June 7, 2024, Section IX.B. S*ee also* GOOG-DOJ-06605325 at -326; [redacted].
[151] *See* Expert Report of Dr. Joshua Gans, June 7, 2024, Section IX.B.
[152] *See* Expert Report of Dr. Joshua Gans, June 7, 2024, Section IX.B.

participants, and because of the confidentiality of the NBA, such advantages were not disclosed to other participants.[153] Nevertheless, Google publicly represented that "All participants in the unified auction, including Ad Exchange and third-party exchanges, compete equally for each impression on a net basis."[154]

54. I also understand that, notwithstanding Google's representation that all auction participants competed equally, Bernanke created an unlevel playing field. Specifically, I understand that under Bernanke, GDN manipulates advertisers' bids before sending them to AdX and that Bernanke advantages GDN bidders over non-GDN bidders, counter to Google's representations of equal footing among all auction participants.[155]

E. State Deceptive Trade Practice Statutes

55. The Plaintiff States allege that Google engaged in unfair, false, deceptive, and misleading business practices related to their display advertising technology and changes it made to the auctions for web display ads during the period of at least 2013 to the present. Below I summarize the relevant statutes for each of the Plaintiff States, including any factors that each state's statute deem relevant in determining the amount of civil penalties.

56. **Alaska:** The Alaska Unfair Trade Practices and Consumer Protection Act ("AUTPCPA") declares unfair or deceptive acts or practices in the conduct of trade or commerce unlawful.[156] The State of Alaska alleges that Google has violated the AUTPCPA, specifically by "engaging in any other conduct creating a likelihood of confusion or of misunderstanding and that

[153] *See* Expert Report of Dr. Joshua Gans, June 7, 2024, Section IX.B.
[154] "How Open Bidding Works," Google Ad Manager, November 20, 2019, available at https://web.archive.org/web/20191120001210/https:/support.google.com/admanager/answer/7128958, accessed 5/23/2024. Note, this is the earliest available version of this representation on Google's website that I was able to locate.
[155] *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 8.A, Section 8.B, Section 8.G.
[156] Alaska Unfair Trade Practices and Consumer Protection Act 45.50.471(a), available at **https://www.akleg.gov/basis/statutes.asp#45.50.561**, accessed 4/3/2024.

misleads, deceives, or damages a buyer or a competitor in connection with the sale or advertisement of goods or services" and “using or employing deception, fraud, false pretense, false promise, misrepresentation, or knowingly concealing, suppressing, or omitting a material fact with intent that others rely upon the concealment, suppression, or omission in connection with the sale or advertisement of goods or services whether or not a person has in fact been misled, deceived, or damaged.”[157] The AUTPCPA allows for a civil penalty of between $1,000 and $25,000 per violation.[158]

57. **Arkansas:** The Arkansas Deceptive Trade Practices Act makes unlawful and prohibits deceptive and unconscionable trade practices.[159] Arkansas alleges that Google has violated the Arkansas Deceptive Trade Practices Act.[160] The Arkansas Deceptive Trade Practices Act allows for a penalty of up to $10,000 to be paid to the state for each violation.[161]

58. **Florida:** The Florida Deceptive and Unfair Trade Practices Act outlaws any “unfair methods of competition, unconscionable acts or practices, and unfair or deceptive acts or practices in the conduct of any trade or commerce.”[162] Florida alleges that Google’s actions in relation to AdTech violate the Florida Deceptive and Unfair Trade Practices Act and are "immoral, unethical, oppressive, unscrupulous, or substantially injurious” to Florida consumers.[163] The Florida

[157] Complaint at ¶681; Alaska Unfair Trade Practices and Consumer Protection Act 45.50.471(b)(11-12), available at **https://www.akleg.gov/basis/statutes.asp#45.50.561**, accessed 4/3/2024.
[158] Alaska Unfair Trade Practices and Consumer Protection Act 45.50.551(b), available at **https://www.akleg.gov/basis/statutes.asp#45.50.561**, accessed 4/3/2024.
[159] Arkansas Code § 4-88-107, available at **https://law.justia.com/codes/arkansas/2020/title-4/subtitle-7/chapter-88/subchapter-1/section-4-88-107/**, accessed 4/3/2024.
[160] Complaint at ¶685.
[161] Arkansas Code § 4-88-113, available at **https://law.justia.com/codes/arkansas/2020/title-4/subtitle-7/chapter-88/subchapter-1/section-4-88-113/**, accessed 4/3/2024.
[162] 2023 Florida Statutes 501.204, available at **http://www.leg.state.fl.us/statutes/index.cfm?App_mode=Display_Statute&Search_String=&URL=0500-0599/0501/Sections/0501.204.html**, accessed 4/3/2024.
[163] Complaint at ¶¶687-688.

Deceptive and Unfair Trade Practices Act calls for a civil penalty not to exceed $10,000 for each violation.[164]

59. **Idaho:** Idaho's Consumer Protection Act ("ICPA") and Idaho Rules of Consumer Protection ("ICPR") prohibit unfair methods of competition and unfair or deceptive actions or practices in the conduct or trade or commerce.[165] The State of Idaho alleges that Google has violated the ICPA and ICPR, including by "representing that goods or services have sponsorship, approval, characteristics, ingredients, uses, benefits, or quantities that they do not have or that a person has a sponsorship, approval, status, affiliation, connection, qualifications, or license that he does not have;" "representing that goods or services are of a particular standard, quality, or grade, if they are of another;" "advertising goods or services with the intent not to sell them as advertised;" and "engaging in any act or practice that is otherwise misleading, false, or deceptive to consumers, such as making any claim or representation, or omitting any material or relevant fact, concerning goods or services that directly, or by implication, has the capacity, tendency, or effect of deceiving or misleading a consumer acting reasonably under the circumstances."[166] The ICPA allows for a civil penalty up to $5,000 per violation.[167]

[164] 2023 Florida Statutes 501.2075, available at **http://www.leg.state.fl.us/statutes/index.cfm?App_mode=Display_Statute&Search_String=&URL=0500-0599/0501/Sections/0501.2075.html**, accessed 4/3/2024. I understand that, while Florida's statute does not include specific factors, Florida courts have stated that certain factors may be "persuasive," including "the degree of culpability, history of prior such conduct, ability to pay, effect on ability to pay, effect on the ability to continue to do business, and such other matters as justice may require." *See Office Of The Att'y Gen., State Of Florida, Dep't Of Legal Affairs v. All USA Van Lines Inc.*, No. CACE18029679, ¶ 101 (Fla. 17th Cir. Ct. May 20, 2022).
[165] Idaho Consumer Protection Act, available at **https://legislature.idaho.gov/statutesrules/idstat/title48/t48ch6/**, accessed 3/12/2024; Idaho Rules of Consumer Protection, available at **https://adminrules.idaho.gov/rules/current/04/040201.pdf**, accessed 3/12/2024.
[166] Complaint at ¶¶690-696.
[167] Idaho Consumer Protection Act, available at **https://legislature.idaho.gov/statutesrules/idstat/title48/t48ch6/**, accessed 3/12/2024.

60. **Indiana:** The Indiana Deceptive Consumer Sales Act deems unfair, abusive, or deceptive acts, omissions, or practices in connection with a consumer transaction to be unlawful.[168] The State of Indiana alleges that Google has knowingly committed acts, omissions, or practices in violation of the state's Deceptive Consumer Sales Act.[169] The Deceptive Consumer Sales Act allows for penalties not exceeding $5,000 per violation.[170]

61. **Kentucky:** Kentucky Revised Statutes ("KRS") Chapter 367 declares unlawful "unfair, false, misleading, or deceptive acts or practices in the conduct of any trade or commerce."[171] The Commonwealth of Kentucky alleges that Google has willfully engaged in and is willfully engaging in unlawful conduct in the course of trade or commerce, in violation of KRS Chapter 367..[172] KRS Chapter 367 allows for the Attorney General to recover a civil penalty not to exceed $2,000 per violation.[173]

62. **Louisiana:** The Louisiana Unfair Trade Practices and Consumer Protection Law ("LUTPA") deems unfair methods of competition and unfair or deceptive acts or practices in the conduct of any trade or commerce to be unlawful.[174] The State of Louisiana alleges that Google's alleged misconduct constitute a pattern of unfair and deceptive trade practices in violation of

[168] Indiana Deceptive Consumer Sales Act, available at **https://law.justia.com/codes/indiana/2022/title-24/article-5/chapter-0-5/section-24-5-0-5-3/**, accessed 3/12/2024.
[169] Complaint at ¶¶697-703.
[170] Indiana Deceptive Consumer Sales Act, available at **https://law.justia.com/codes/indiana/2022/title-24/article-5/chapter-0-5/section-24-5-0-5-3/**, accessed 3/12/2024.
[171] Kentucky Revised Statutes 367.170, available at **https://apps.legislature.ky.gov/law/statutes/statute.aspx?id=34914**, accessed 4/3/2024.
[172] Complaint at ¶¶706-708.
[173] Kentucky Revised Statutes 367.990, available at **https://apps.legislature.ky.gov/law/statutes/statute.aspx?id=48888**, accessed 4/3/2024.
[174] Louisiana Unfair Trade Practices and Consumer Protection Law, available at **https://legis.la.gov/Legis/Law.aspx?d=104031**, accessed 3/12/2024.

LUTPA.[175] For any method, act, or practice entered into with the intent to defraud, LUTPA allows for penalties not exceeding $5,000 per violation.[176]

63. **Mississippi:** The Mississippi Consumer Protection Act declares unlawful unfair methods of competition and unfair or deceptive trade practices or acts in the conduct of any trade or commerce.[177] The State of Mississippi alleges that Google's alleged misconduct was unfair and deceptive to the consumers of Mississippi and thus violates the Consumer Protection Act.[178] Mississippi's Consumer Protection Act allows for penalties not exceeding $10,000 per violation.[179]

64. **Missouri:** Missouri's Merchandising Practices Act prohibits "deception, fraud, false pretense, false promise, misrepresentation, unfair practice or the concealment, suppression, or omission of any material fact in connection with the sale or advertisement of any merchandise in trade or commerce…"[180] The State of Missouri alleges that Google's alleged misconduct "were and are unfair and deceptive practices in violation of Missouri's Merchandising Practices Act."[181] Missouri's Merchandising Practices Act allows for a civil penalty not to exceed $1,000 per violation to be paid to the state.[182]

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[175] Complaint at ¶¶711-718.
[176] Louisiana Unfair Trade Practices and Consumer Protection Law, available at **https://legis.la.gov/Legis/Law.aspx?d=104031**, accessed 3/12/2024.
[177] Mississippi Consumer Protection Act, available at **https://law.justia.com/codes/mississippi/2020/title-75/chapter-24/subchapter-generalprovisions/section-75-24-19/**, accessed 3/12/2024.
[178] Complaint at ¶¶719-721.
[179] Mississippi Consumer Protection Act, available at **https://law.justia.com/codes/mississippi/2020/title-75/chapter-24/subchapter-generalprovisions/section-75-24-19/**, accessed 3/12/2024.
[180] Missouri Statute 407.020, available at **https://revisor.mo.gov/main/OneSection.aspx?section=407.020&bid=48371**, accessed 4/3/2024. The Missouri statute does not include factors to consider in assessing a penalty; however, in one case a lower court's decision was affirmed, with the deciding court stating that penalties were "appropriate in view of the magnitude and seriousness of the violations … the lack of a bona fide error, and the need to deter." *See State ex rel. Nixon v. Consumer Auto. Res., Inc.*, 882 S.W.2d 717, 722 (Mo. Ct. App. 1994).
[181] Complaint at ¶¶722-723.
[182] Missouri Statute 407.100, available at **https://revisor.mo.gov/main/OneSection.aspx?section=407.100&bid=23016**, accessed 4/3/2024.

65. **Montana:** The Montana Unfair Trade Practices and Consumer Protection Act outlaws "unfair methods of competition and unfair or deceptive acts or practices in the conduct of any trade or commerce."[183] The State of Montana alleges that Google's alleged misconduct was and is a willful violation of Montana's Unfair Trade Practices and Consumer Protection Act.[184] The Montana Unfair Trade Practices and Consumer Protection Act allows for the state to fine a violator a fee not to exceed $10,000 per violation.[185]

66. **Nevada:** The Nevada Deceptive Trade Practices Act outlaws numerous acts defined as "deceptive trade practice(s)."[186] The State of Nevada claims that Google's alleged conduct violates the Nevada Deceptive Trade Practices Act by willfully engaging in a deceptive trade practice by "knowingly mak[ing] a false representation as to the characteristics, ingredients, uses, benefits, alterations or quantities of goods or services for sale or lease or a false representation as to the sponsorship, approval, status, affiliation or connection of a person therewith;" engaging in a deceptive trade practice by "represent[ing] that goods or services for sale or lease are of a particular standard, quality or grade, or that such goods are of a particular style or model, if he or

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[183] Montana Code Annotated 30-14-103, available at **https://leg.mt.gov/bills/mca/title_0300/chapter_0140/part_0010/section_0030/0300-0140-0010-0030.html**, accessed 4/3/2024. I understand that the Montana statute is based on the Federal Trade Commission Act ("FTCA") and directs courts to consider FTC and federal court interpretations of the FTCA when considering the Montana statute. *See* Montana Annotated Code 30-14-104, available at **https://leg.mt.gov/bills/mca/title_0300/chapter_0140/part_0010/section_0040/0300-0140-0010-0040.html**, accessed 5/30/2024. Federal courts have identified factors to consider when assessing fines under the FTCA including the good faith or bad faith of the defendants, the injury to the public, the defendants' ability to pay and the extent to which defendants have benefited from the violations, whether continuing violations have a detrimental effect on the public, whether defendant can eliminate the effects of the violation if it were motivated to do so, and the penalties awards must result in effective deterrence lest potential violators "regard the statutory penalty 'as nothing more than an acceptable cost of violation.'" *See United States v. Phelps Dodge Indus., Inc*., 589 F. Supp. 1340, 1362 (S.D.N.Y. 1984).

[184] Complaint at ¶¶724-725; See also, *Rohrer v. Knudson*, 203 P.3d 759 (Mont. 2009) where the Montana Supreme Court determined "an unfair act or practice is one which offends established public policy and which is either immoral, unethical, oppressive, or unscrupulous."

[185] Montana Code Annotated 30-14-142, available at **https://leg.mt.gov/bills/mca/title_0300/chapter_0140/part_0010/section_0420/0300-0140-0010-0420.html**, accessed 4/3/2024.

[186] Nevada Revised Statutes 598.0915-598.0925, available at **https://www.leg.state.nv.us/nrs/NRS-598.html#NRS598Sec0999**, accessed 4/3/2024.

she knows or should know that they are of another standard, quality, grade, style or model.;" engaging in a deceptive trade practice by "advertis[ing] goods or services with the intent not to sell them as advertised;" engaging in a deceptive trade practice by "knowingly misrepresent[ing] the legal rights, obligations or remedies of a party to a transaction; and" "fails to disclose a material fact in connection with the sale of goods or services."[187] Under the Nevada Deceptive Trade Practices Act, an entity that has willfully engaged in a deceptive trade practice may be fined up to $15,000 for each violation.[188]

67. **North Dakota:** The North Dakota Century Code ("N.D.C.C.") deems unlawful "the act, use, or employment by any person of any deceptive act or practice, fraud, false pretense, false promise, or misrepresentation, with the intent that others rely thereon in connection with the sale or advertisement of any merchandise, whether or not any person has in fact been misled, deceived, or damaged thereby." The N.D.C.C. also defines as unlawful the "use, or employment by any person of any act or practice, in connection with the sale or advertisement of any merchandise, which is unconscionable, or which causes or is likely to cause substantial injury to a person which is not reasonably avoidable by the injured person and not outweighed by countervailing benefits to consumers or to competition."[189] The State of North Dakota alleges that

[187] Complaint at ¶¶729-730; Nevada Revised Statutes 598.0915(5,7,9), 598.092(8), 598.0923(2), available at **https://www.leg.state.nv.us/nrs/NRS-598.html#NRS598Sec0999**, accessed 4/3/2024.
[188] I understand that in July 2023, Nevada's statute was revised to increase maximum penalties per violation from $5,000 to $15,000, but that the new version of the statute is not yet available online. I further understand that the increased penalty is the appropriate maximum to apply in this matter. *See* unrevised statute at Nevada Revised Statutes 598.0999, available at **https://www.leg.state.nv.us/nrs/NRS-598.html#NRS598Sec0999**, accessed 4/3/2024.
[189] North Dakota Century Code, available at **https://ndlegis.gov/cencode/t51c15.pdf#nameddest=51-15-11**, accessed 3/12/2024.

Google has and continues to engage in unlawful practices in violation of the N.D.C.C.[190] The N.D.C.C. allows for penalties of not more than $5,000 per violation.[191]

68. **Puerto Rico:** The Puerto Rico Antitrust Act declares "unfair methods of competition, and unfair or deceptive acts or practices in trade or commerce" to be unlawful.[192] The Commonwealth of Puerto Rico claims that Google's alleged behavior was unfair and deceptive to its consumers and thus violates the Puerto Rico Antitrust Act.[193] An entity found to have violated the Puerto Rico Antitrust Act may receive a penalty of up to $5,000 per violation.[194]

69. **South Carolina:** The South Carolina Unfair Trade Practices Act ("SCUTPA") declares unlawful unfair methods of competition and unfair or deceptive acts or practices in the conduct of any trade or commerce.[195] The State of South Carolina alleges that Google's alleged misconduct are "are offensive to established public policy, immoral, unethical, or oppressive" and that Google willfully violated SCUTPA.[196] For willfully using a method, act or practice declared unlawful by the law, SCUPTA allows for penalties not exceeding $5,000 per violation.[197]

70. There is also case law in South Carolina that provides further guidance on factors to consider when assessing a civil penalty under SCUTPA:

(a) the degree of culpability and good or bad faith of the defendant;

(b) the duration of the defendant's unlawful conduct;

(c) active concealment of information by the defendant;

[190] Complaint at ¶¶732-739.
[191] North Dakota Century Code, available at **https://ndlegis.gov/cencode/t51c15.pdf#nameddest=51-15-11**, accessed 3/12/2024.
[192] 10 L.P.R.A. § 259, available at **https://casetext.com/statute/laws-of-puerto-rico/title-ten-commerce/subtitle-1-regulation-of-business-generally/chapter-13-monopolies-and-restraint-of-trade/259-fair-competition**, accessed 4/3/2024.
[193] Complaint at ¶741.
[194] P.R. Laws tit. 10, § 259(i)
[195] South Carolina Unfair Trade Practices Act, available at **https://www.scstatehouse.gov/code/t39c005.php**, accessed 3/12/2024.
[196] Complaint at ¶¶744-751.
[197] South Carolina Unfair Trade Practices Act, available at **https://www.scstatehouse.gov/code/t39c005.php**, accessed 3/12/2024.

(d) defendant's awareness of the unfair or deceptive nature of their conduct;

(e) prior similar conduct by the defendant;

(f) the defendant's ability to pay;

(g) the deterrence value of the assessed penalties;

(h) the actual impact or injury to the public resulting from defendant's unlawful conduct.[198]

71. **South Dakota:** South Dakota's Codified Laws ("SDCL") state that for any person to "knowingly act, use, or employ any deceptive act or practice, fraud, false pretense, false promises, or misrepresentation or to conceal, suppress, or omit any material fact in connection with the sale or advertisement of any merchandise, regardless of whether any person has in fact been misled, deceived, or damaged thereby" is an unlawful deceptive act.[199] The State of South Dakota alleges that Google violated the SDCL, causing adverse effects for the businesses of the state and causing damage to the person of the state.[200] For intentional unlawful acts, the SDCL allows for penalties of not more than $2,000 per violation.[201]

72. **Texas:** Section 17.47 of Texas' Deceptive Trade Practices Act ("DTPA") gives the Office of the Attorney General the authority to bring an action "[w]henever the consumer protection division has reason to believe that any person is engaging in, has engaged in, or is about to engage in any act or practice declared to be unlawful by" the DTPA.[202] Under the DTPA, false, misleading, or deceptive acts or practices in the conduct of any trade or commerce are deemed

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[198] *State ex rel. Wilson v. Ortho-McNeil-Janssen Pharm., Inc.*, 777 S.E.2d 176, 203 (S.C. 2015). The opinion also states that "we further authorize our able trial judges to consider any other factors they deem appropriate under the circumstances."

[199] South Dakota Codified Laws, available at **https://sdlegislature.gov/Statutes/37-24**, accessed 3/12/2024.

[200] Complaint at ¶¶752-754.

[201] South Dakota Codified Laws, available at **https://sdlegislature.gov/Statutes/37-24**, accessed 3/12/2024.

[202] Section 17.44 of Texas' DTPA provides that it "shall be liberally construed and applied to promote its underlying purposes, which are to protect consumers against false, misleading, and deceptive business practices, unconscionable actions, and breaches of warranty and to provide efficient and economical procedures to secure such protection." *See* Texas Deceptive Trade Practices Act, available at **https://statutes.capitol.texas.gov/Docs/BC/htm/BC.17.htm**, accessed 3/12/2024.

unlawful and subject to action by the Consumer Protection Division of the Office of the Attorney General.[203] I understand that a "false, misleading, or deceptive act or practice" means any act or series of acts that have the tendency to deceive an average ordinary person, even though that person may have been ignorant, unthinking, or credulous.[204] In addition, false, misleading, or deceptive acts and practices under the DTPA include but are not limited to "representing that services have sponsorship, approval, characteristics, ingredients, uses, benefits, or quantities which they do not have or that a person has a sponsorship, approval, status, affiliation, or connection which he does not have;" "representing that services are of a particular standard, quality, or grade, if they are of another;" "advertising goods or services with the intent not to sell them as advertised;" "representing that an agreement confers or involves rights, remedies, or obligations which it does not have or involve, or which are prohibited by law;" and "failing to disclose information concerning goods or services which was known at the time of the transaction with the intent to induce the consumer into a transaction into which the consumer would not have entered had the information been disclosed."[205]

73. In addition to injunctive relief, the Texas DTPA allows for a civil penalty of not more than $10,000 per violation. The Texas DTPA also provides the following list of factors that the trier of fact shall consider in determining the level of a penalty:

> (1) the seriousness of the violation, including the nature, circumstances, extent, and gravity of any prohibited act or practice;
> (2) the history of previous violations;
> (3) the amount necessary to deter future violations;
> (4) the economic effect on the person against whom the penalty is to be assessed;

[203] Texas Deceptive Trade Practices Act, available at **https://statutes.capitol.texas.gov/Docs/BC/htm/BC.17.htm**, accessed 3/12/2024.
[204] *Spradling v. Williams*, 566 S.W.2d 561 (Tex. 1978).
[205] Complaint at ¶¶674-678.

(5) knowledge of the illegality of the act or practice; and

(6) any other matter that justice may require.[206]

74. **Utah:** The Utah Consumer Sales Practices Act outlaws any deceptive act or practice by a supplier in connection with a consumer transaction.[207] The State of Utah claims that Google's alleged conduct "constitute(s) unconscionable and deceptive practices to the consumers of the State of Utah, therefore Google's conduct violated the Utah Consumer Sales Practices Act…"[208] The Utah Consumer Sales Practices Act asks an enforcing authority to consider the following factors to determine the amount of an imposed fine:

> (a) the seriousness, nature, circumstances, extent, and persistence of the conduct constituting the violation;
>
> (b) the harm to other persons resulting either directly or indirectly from the violation;
>
> (c) cooperation by the supplier in an inquiry or investigation conducted by the enforcing authority concerning the violation;
>
> (d) efforts by the supplier to prevent occurrences of the violation;
>
> (e) the history of previous violations by the supplier;
>
> (f) the need to deter the supplier or other suppliers from committing the violation in the future;
>
> (g) other matters as justice may require. [209]

75. There is no cap on the penalty per violation under Utah's statute.[210]

76. I have been asked to opine on issues related to determining the appropriate amount of the civil penalty in each state.

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[206] Texas Deceptive Trade Practices Act, available at **https://statutes.capitol.texas.gov/Docs/BC/htm/BC.17.htm**, accessed 3/12/2024.

[207] Utah Consumer Sales Practices Act 13-11-4, available at **https://le.utah.gov/xcode/Title13/Chapter11/C13-11_1800010118000101.pdf**, accessed 4/3/2024.

[208] Complaint at ¶756.

[209] Utah Consumer Sales Practices Act 13-11-17(1, 6), available at **https://le.utah.gov/xcode/Title13/Chapter11/C13-11_1800010118000101.pdf**, accessed 4/3/2024.

[210] Utah Consumer Sales Practices Act 13-11-17(6), available at **https://le.utah.gov/xcode/Title13/Chapter11/C13-11_1800010118000101.pdf**, accessed 4/3/2024.

IV. BASIS OF OPINIONS

A. Google's Financial Performance from 2013 to Present Has Been Extraordinary: Google Eclipses All But Three U.S. Companies as Measured by Market Capitalization

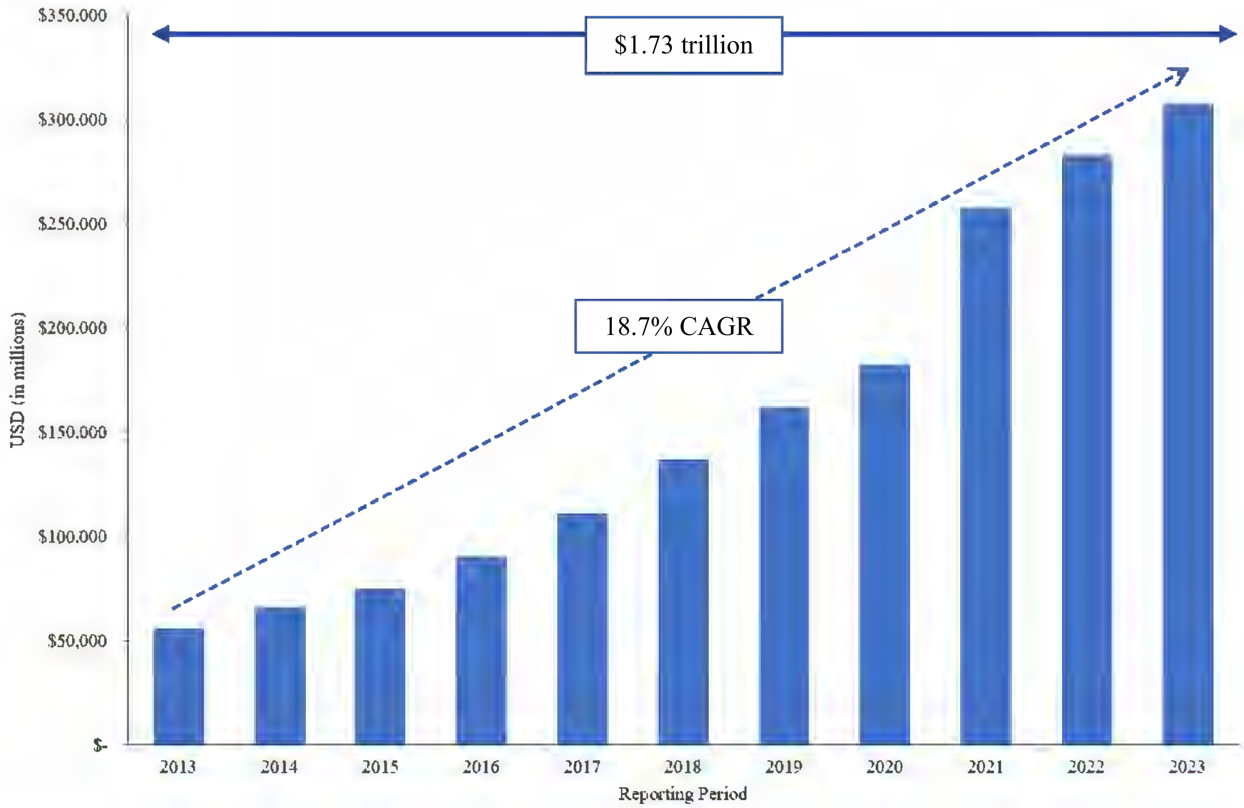
77. Below I provide a summary of Google's financial performance based on the information currently available to me, though I reserve the right to supplement or revise my opinions and conclusions based on updated financial information that becomes available to me up to and during the time of trial. This information is pertinent to my opinion as it establishes Google as highly profitable and successful company during the relevant period and informs the amount necessary to deter Google's misconduct and its ability to pay a penalty related to this misconduct.

i. Google's Overall Revenue, Operating Profit and Net Income Grew at a CAGR of Over 18.5 percent From 2013 through 2023

78. From 2013 through 2023, Google has experienced tremendous growth.[211] Specifically, Google's revenue has grown from $55.52 billion in 2013 to $307.39 billion in 2023, a CAGR of 18.7%.[212] To put this into perspective, the revenue of the average S&P 500 company experienced a 5.0% CAGR over the same period.[213] The company attributes its growth to increased user adoption and usage on mobile devices, advertiser spending, and increased YouTube non-advertising and hardware revenues.[214] In total, Google has grossed approximately $1.73 trillion in revenues from fiscal year 2013 through fiscal year 2023.[215] I have provided graphical illustrations Google's revenue growth in **Chart 1** below.

[211] Throughout this report, I use annual income statement data through December 31, 2023, to make comparisons across years and calculate growth rates. I also report Google's Q1 2024 revenues and earnings based on its latest available quarterly filing. Finally, I report balance sheet data as of March 31, 2024, based on Google's latest available quarterly filings. I reserve the right to update my analyses based on updated financial information made available by Google.
[212] S&P Capital IQ.
[213] S&P Capital IQ.
[214] Alphabet Inc. Form 10-K for the fiscal year ended December 31, 2023, pp. 35-36.
[215] S&P Capital IQ. Additionally, Google earned $80.54 billion in revenue during Q1 2024.

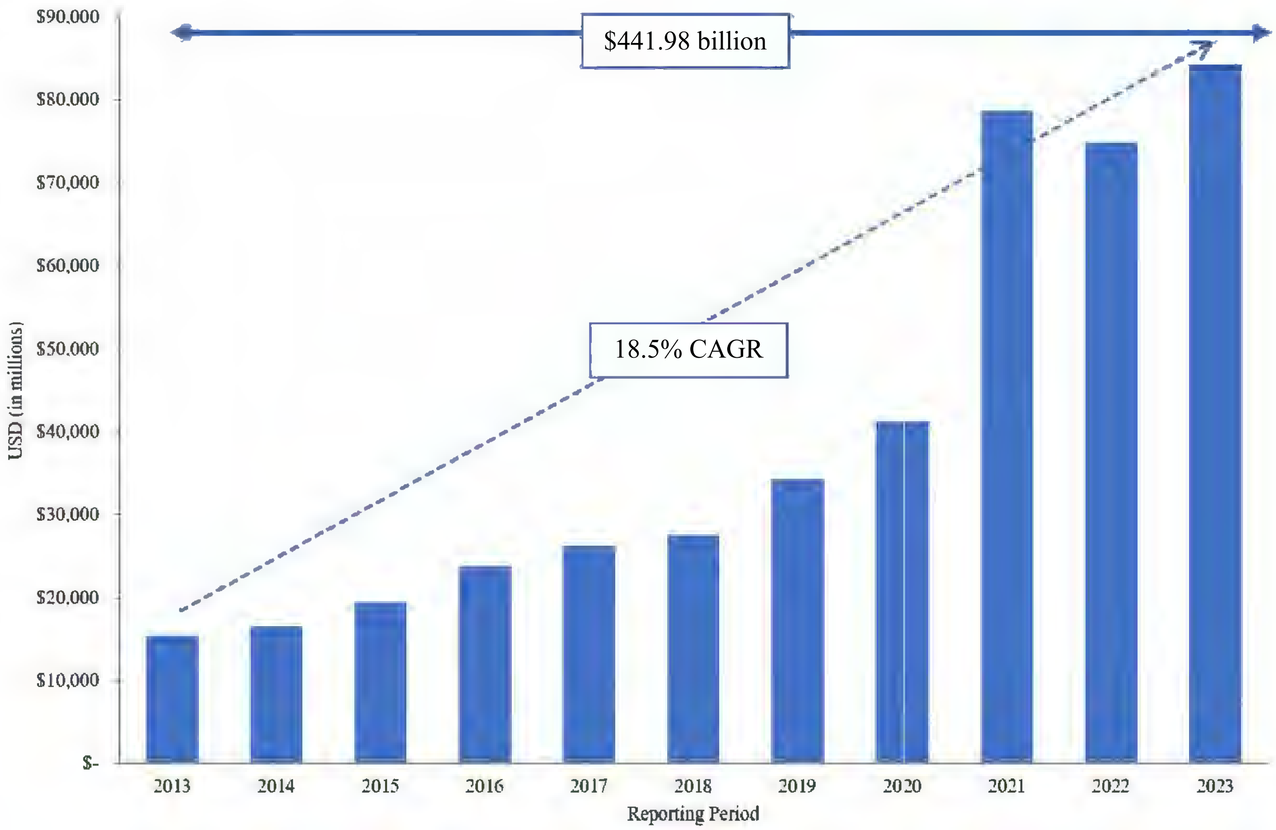
Chart 1[216]
Google's Revenue Growth
2013 –2023



79. Google's revenue growth was also accompanied by growth in profits. Specifically, Google's operating profit has grown from $15.40 billion in 2013 to $84.29 billion in 2023, a CAGR of 18.5%.[217] The operating profit of the average S&P 500 company experienced a 5.6% CAGR over the same period.[218] Google's operating profit margins during this period ranged between 20.1% and 30.6% percent.[219] In total, Google earned $441.98 billion in operating profits between 2013 and 2023.[220] Google's overall operating income growth is depicted in **Chart 2** below.

[216] S&P Capital IQ.
[217] S&P Capital IQ.
[218] S&P Capital IQ.
[219] S&P Capital IQ.
[220] S&P Capital IQ. Additionally, Google earned $25.47 billion in operating profit during Q1 2024. Alphabet Inc. Form 10-Q for the quarterly period ended March 31, 2024.

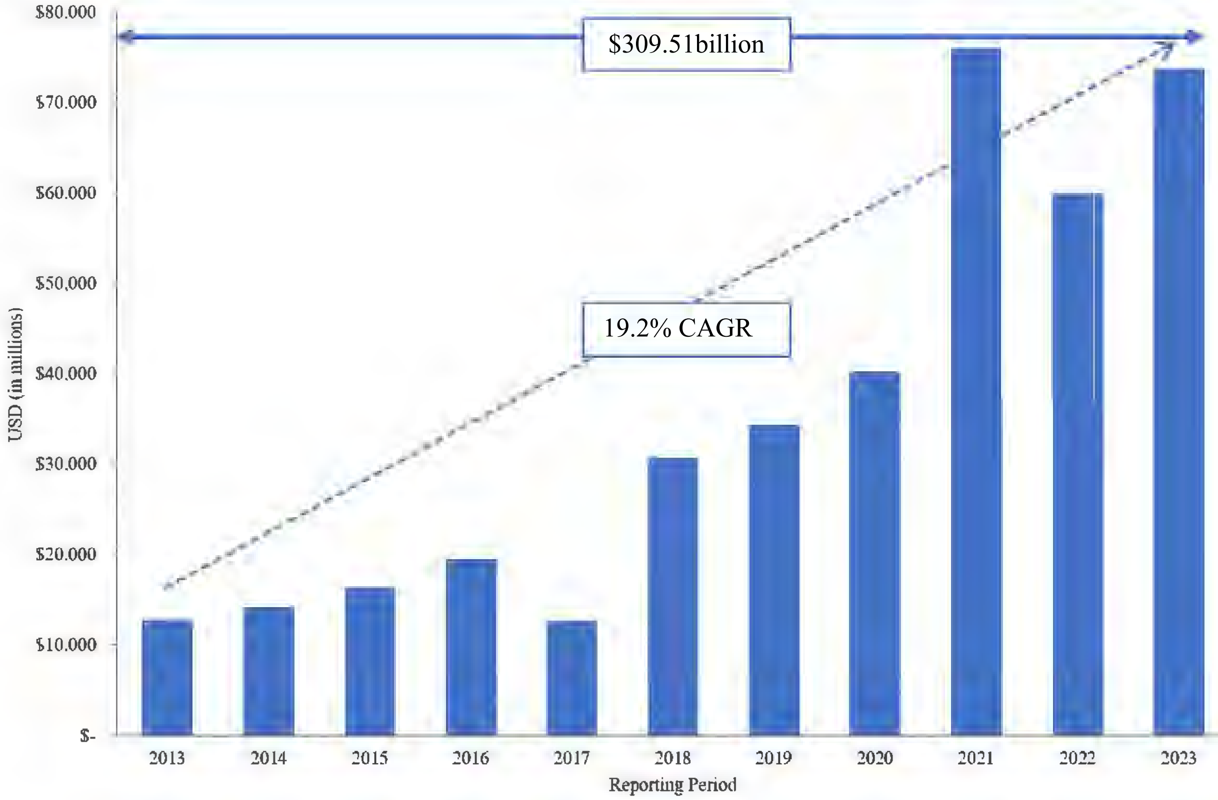
Chart 2[221]
Google's Operating Income Growth
2013 –2023



80. Similarly, Google's net income has grown from $12.73 billion in 2013 to $73.80 billion in 2023, a 19.2% CAGR.[222] The net income of the average S&P 500 company experienced an 6.7% CAGR over the same period.[223] Google's net margins during this period ranged between 11.4% and 29.5% percent.[224] In total, Google earned $390.51 billion in net income between 2013 and 2023.[225] Google's overall net income growth is depicted in **Chart 3** below.

[221] S&P Capital IQ.
[222] S&P Capital IQ.
[223] S&P Capital IQ.
[224] S&P Capital IQ.
[225] S&P Capital IQ. Additionally, Google earned $23.66 billion in net income during Q1 2024.

Chart 3[226]
Google's Net Income Growth
2013 –2023



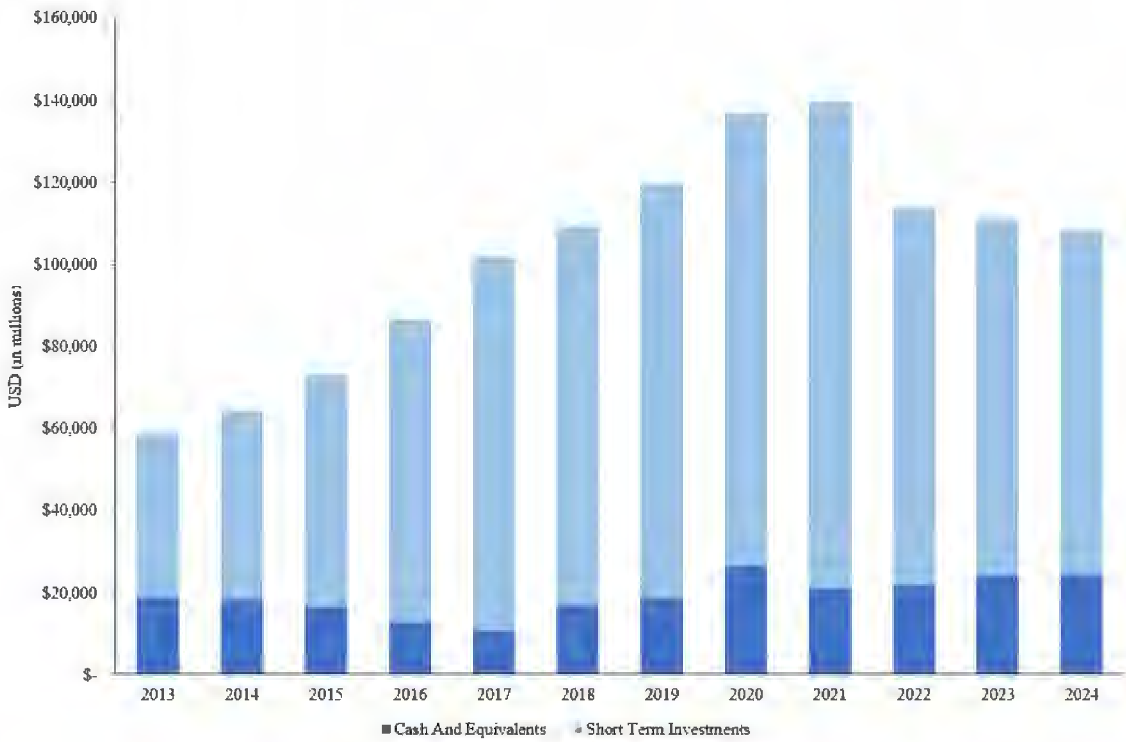
ii. Google Held More Than $108.09 Billion in Cash, Cash Equivalents and Short-Term Investments as of March 31, 2024

81. Google has also increased its cash and equivalents by 29.6% from December 31, 2013 to March 31, 2024.[227] In addition to its cash balances, the company holds short-term marketable securities as its principal sources of liquidity.[228] Google's total cash, cash equivalents and short-term marketable securities balance has grown by over 84.1% from December 31, 2013

[226] S&P Capital IQ. The decrease in net income in 2017 is primarily due to Impacts of the Tax Act. *See* Alphabet Inc, 10-K filed February 6, 2018, p. 80. A decrease in net income in 2022 is primarily due to the 2017 Tax Cuts and Jobs Act, effective January 1, 2022 which required research and development costs to be capitalized and amortized. This resulted in higher cash taxes for 2022. *See* Alphabet Inc, 10-K filed February 3, 2023, p. 81.
[227] Alphabet Inc. Form 10-Ks for fiscal years 2013-2023; Alphabet Inc. Form 10–Q for the quarterly period ended March 31, 2024; S&P Capital IQ.
[228] Alphabet Inc. Form 10-K for the fiscal year ended December 31, 2023, p. 40.

through March 31, 2024.[229] As of March 31, 2024, this balance reached $108.09 billion.[230] Google's cash and equivalents and short-term investments growth is illustrated in **Chart 4** below.

Chart 4[231]
Google's Cash and Short-Term Investments Balance
Reporting Periods December 31, 2013 – March 31, 2024



iii. Google's Stock Has Outperformed the Market and It Has Grown to be the Fourth Largest U.S. Company by Market Capitalization

82. Unsurprisingly, given its outstanding growth and profitability, Google's stock has outperformed market indices such as the S&P 500 and the Nasdaq Composite. An indication of Google's success is provided by the fact that it has accumulated such a significant amount of cash, cash equivalents and short-term marketable securities that during its 2024 Q1 Earnings Call on

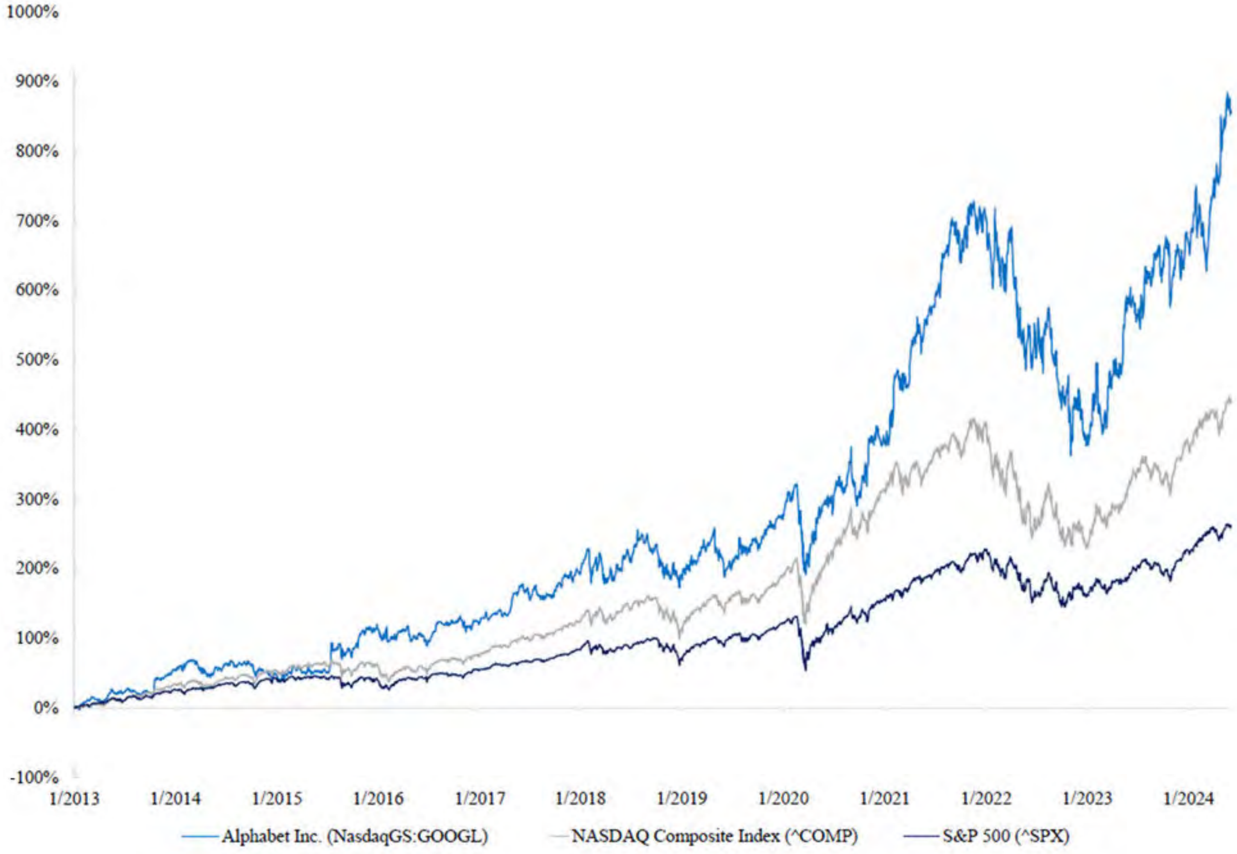
[229] Alphabet Inc. Form 10-Ks for fiscal years ended 2013 – 2023; Alphabet Inc. Form 10–Q for the quarterly period ended March 31, 2024; S&P Capital IQ.
[230] S&P Capital IQ.
[231] Alphabet Inc. Form 10-Ks for fiscal years ended 2013 – 2023; Alphabet Inc. Form 10–Q for the quarterly period ended March 31, 2024; S&P Capital IQ.

April 25, 2024, it announced that it will "be adding a quarterly dividend of $0.20 per share to [its] capital return program as well as a new $70 billion authorization in share repurchases."[232] The market reacted positively to this news as the company's Class A shares rose by 10.2%, the largest single-day gain since 2015.[233] Google's market cap increased from $1.95 trillion to $2.14 trillion, making it just one of four U.S. companies with a market cap of over $2 trillion.[234]

83. Google's stock price has grown from approximately $18.08 per share as of January 2, 2013 to $173.17 per share as on June 3, 2024 a few days prior to this report's issuance, which represents a cumulative growth of 857.73% and an annual return of nearly 22%.[235] This is 3.28 times the growth of the S&P 500 and 1.95 times the growth of the Nasdaq Composite over the same period.[236] This comparative growth is illustrated graphically in **Chart 5**.

[232] Alphabet Inc., Q1 2024 Earnings Call, April 25, 2024.
[233] Bloomberg.
[234] Bloomberg; S&P Capital IQ.
[235] Based on closing stock price is as of June 3, 2024 per S&P Capital IQ.
[236] The S&P 500 (SPX) and the Nasdaq Composite (COMP) have grown 261.28% and 440.72% respectively since the first trading day of 2013. S&P Capital IQ.

Chart 5[237]
Google's Stock Performance Relative to S&P 500 and Nasdaq Composite Indices
January 2, 2013 – June 3, 2024



84. Google has also become one of the world's largest companies by market capitalization.[238] Currently valued at $2.15 trillion, Google is the fourth largest company by market capitalization in the world.[239] In fact, it is one of only seven companies worldwide with a market capitalization of over $1 trillion.[240] See **Chart 6** below.

[237] S&P Capital IQ.
[238] Market capitalization measures the market value of the firm's equity, and it is calculated as the company's common shares outstanding multiplied by the price per share. *See* Berk and DeMarzo, *Corporate Finance*, 3rd Edition, p. 27.
[239] S&P Capital IQ.
[240] S&P Capital IQ.

Chart 6[241]
Google's Market Capitalization Growth
January 2, 2013– June 3, 2024

85. **Chart 7** puts Google's size into context. It is now the fourth largest company in the world as measured by market capitalization. Google alone has a larger market capitalization than ExxonMobil, Walmart, Coca-Cola, Nike, AT&T, Disney, Dell, Caterpillar and American Express combined.[242]

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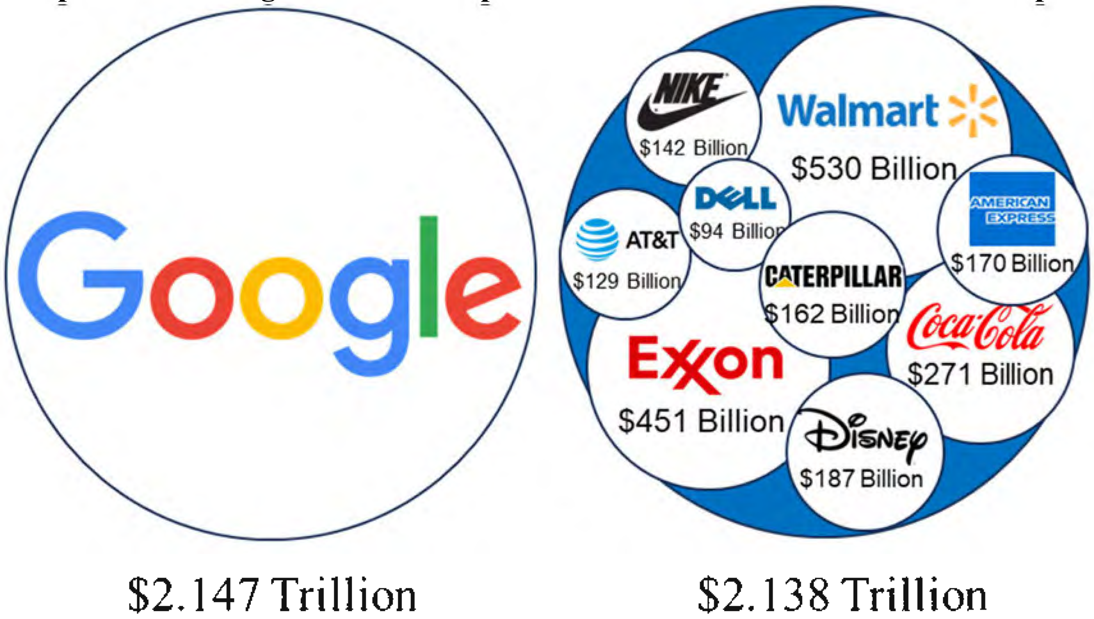
[241] S&P Capital IQ.
[242] S&P Capital IQ.

Chart 7[243]
Comparison of Google's Market Capitalization to Several Well-Known Companies



Note: Market Cap as of 6/3/2024.
Source: S&P Capital IQ.

B. Google's Growth and Profitability During the Relevant Period Have Been Driven by Advertising

86. Google's financial reports demonstrate that its success is driven primarily by advertising.[244] Google's advertising revenue in 2013 was $51.07 billion, approximately 92 percent of its overall revenue.[245] By 2023, Google's advertising revenue grew to $237.86 billion or 77 percent of its overall revenue, which represents a 16.6% CAGR.[246] Although Google's advertising revenue as a percentage of its overall revenue has been declining over time as Google diversifies into other businesses, Google derives most if not all of its profits each year from advertising.

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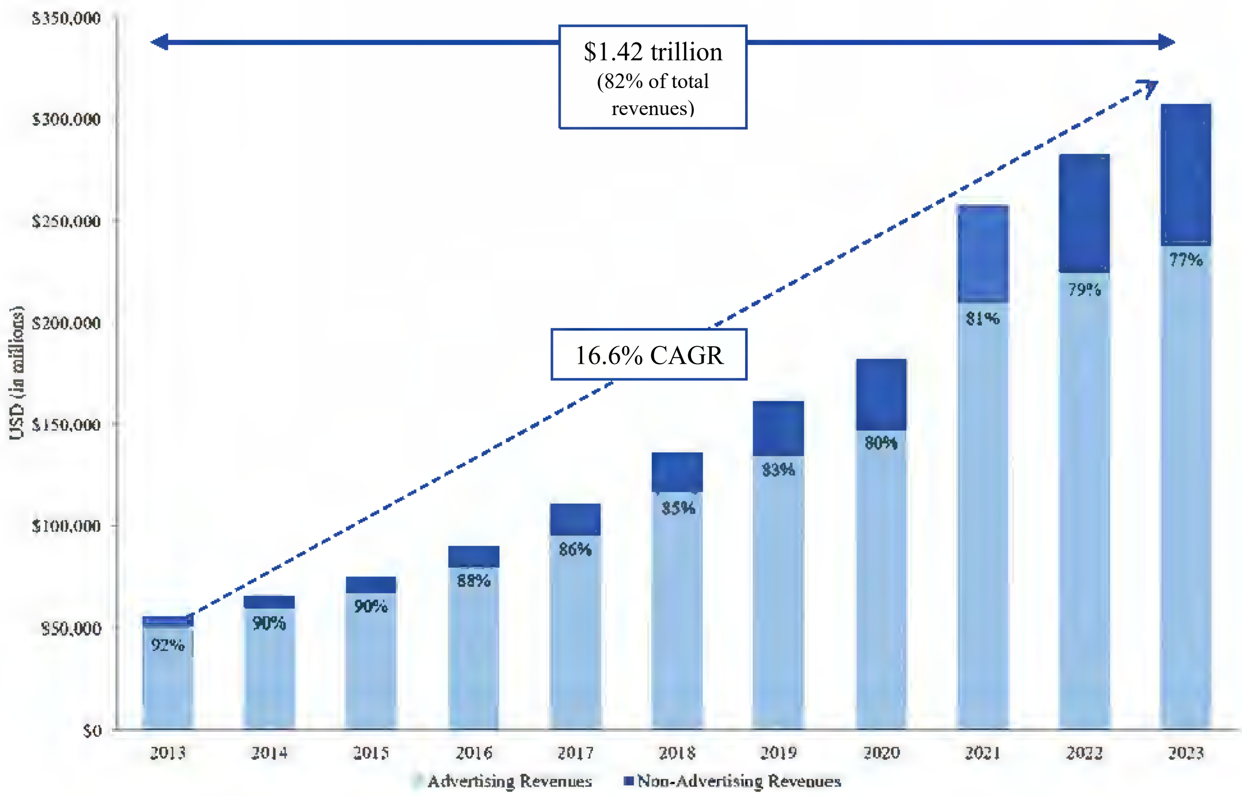
[243] S&P Capital IQ.
[244] *See also* "How We Make Money with Advertising, Google, available at https://howwemakemoney.withgoogle.com/, accessed 1/10/2024 ("Google's main source of revenue is advertising.")
[245] Alphabet Inc. Form 10-K for the fiscal year ended December 31, 2015 pp. 24-25.; S&P Capital IQ.
[246] Alphabet Inc. Form 10-K for the fiscal year ended December 31, 2015 pp. 24-25; Alphabet Inc. Form 10-K for the fiscal year ended December 31, 2023 pp. 35-36; S&P Capital IQ.

Overall, from 2013 through 2023, advertising revenue comprised $1.42 trillion (or 82 percent) of Google's total revenues of $1.73 trillion.[247] Google's reliance on advertising revenue is illustrated below in **Chart 8.**

Chart 8[248]
Google's Advertising Revenues as a Portion of Total Revenues
2013 to 2023



87. Google does not report its profits from advertising in its SEC filings and has also not produced that information in this litigation. However, I have estimated Google's advertising operating profit based upon the business segment information contained in Google's SEC filings. Google's SEC filings for 2020 through 2023 report the results of its advertising operations under the Google Services segment, including results going back to 2018.[249] Accordingly, for 2018

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[247] Alphabet Inc. Form 10-Ks for fiscal years ended 2015 - 2023; S&P Capital IQ. Additionally, Google earned $61.66 billion in advertising revenue during Q1 2024, which compromises 77% of its total revenue of $80.54 billion in the same quarter. Alphabet Inc. Form 10-Q for the quarterly period ended March 31, 2024.
[248] Alphabet Inc. Form 10-Ks for fiscal years ended 2015 – 2023; S&P Capital IQ.
[249] S&P Capital IQ.

through 2023, I estimated Google's operating profit from advertising by applying operating profit margins of the Google Services segments to Google's advertising revenue. Google's SEC filings for 2012 through 2017 report the results of its advertising operations under the "Google" segment.[250] Accordingly, for 2013 through 2017, I estimated Google's operating profit from advertising by applying operating profit margins of the "Google" segment to Google's advertising revenue.

88. [redacted]

[250] S&P Capital IQ

[251] Alphabet Inc. Form 10-Ks for fiscal years ended 2012 – 2023; S&P Capital IQ. Additionally, Google earned $24.43 billion in operating profits in advertising during Q1 2024. Alphabet Inc. Form 10-Q for the quarterly period ending March 31, 2024.

[redacted]

89. **Chart 10** shows Google's advertising operating profit as a percentage of its total operating profit each year.

[252] Alphabet Inc. Form 10-Ks for fiscal years ended 2013 – 2023; S&P Capital IQ.

[redacted]

90. As can be seen in **Chart 10**, for most years reported above, [redacted]

C. Google Earned Operating Profits From Display Advertising in the Plaintiff States Between 2013 and 2023

91. Based on Google's verified discovery responses, Google has not identified the state of residence, organization or incorporation of any of its customers and has not otherwise produced,

[253] Alphabet Inc. Form 10-Ks for fiscal years ended 2013 – 2023; S&P Capital IQ.

among other relevant requested data, revenue and profit specific to the Plaintiff States in this matter.[254] Based on the information currently available at this time, I have estimated the share of Google's display advertising revenue and profit associated with the Plaintiff States using the below described methodology.[255] This method is reliable as it is based on financial data as produced and/or publicly reported by Google, as well as data produced by the U.S. Census Bureau, a common source of demographic data. The proxies I use below are reasonable based on my financial and economic experience, education, and training.

92. To determine the revenue and profits related to Google's display advertising segment, I rely on internal [redacted] ("P&Ls") as produced by Google.[256] I understand that [redacted].[257] In order to isolate the revenue and profit associated with the display advertising products at issue in this matter, I only include revenue and profits from the P&Ls related to AdSense for Content, AdX, Doubleclick Bid Manager, AdMob, Doubleclick for Publishers, AdServing, Ad Manager, AwBid, Display & Video 360, Campaign Manager, and

[254] *See* Defendant Google LLC's Responses and Objections to Plaintiffs' Second Set of Interrogatories, April 8, 2024 at 7-10 ("With regard to subpart (b) of Interrogatory 2 [the customer's location(s) and state of residence, organization, or incorporation], [redacted]

[255] My opinions and conclusions herein are based on the information currently available to me, though I reserve the right to supplement or revise my opinions and conclusions based on updated information that becomes available to me up to and during the time of trial.

[256] [redacted] Google's SEC filings also include revenue related to Google's display advertising products within the "Google Network" vertical; however, I understand that Google Network also includes revenue for products outside of display advertising, for example AdSense for Search. *See, for example,* Alphabet Inc. Form 10-K for the fiscal year ended December 31, 2017, p. 31. I therefore rely on Google's internal display advertising P&Ls.

[257] *See* GOOG-AT-MDL-004326981 at -994.

Google Ads, which I understand are the products at issue in this matter.[258] The P&Ls available to me in production include information on revenue,[259] costs, and operating profit for these various Google display advertising products for the years 2013 to 2022. To extrapolate to the year 2023, I conservatively assume the same revenue, costs, and operating profit in 2023 as there were in 2022, i.e. I assume no growth.

93. To estimate the share of Google's overall display advertising revenue and profit described above that is attributable to the Plaintiff States, I take two additional steps. First, I estimate Google's U.S. display advertising revenues and profits by multiplying Google's annual display advertising revenues and profits from Google's P&Ls as described above by the percent of its overall revenues attributable to the United States in each respective year as reflected in Google/Alphabet SEC filings.

94. I then estimate display advertising revenue and profit associated with the Plaintiff States. The U.S. Census Bureau collects an assortment of data about the people and economy of the United States, including data on internet use, which it has collected as a part of the American Community Survey ("ACS") since 2013.[260] ACS data is available for the United States as a whole,

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258 [redacted]

259 [redacted]

260 "Why We Ask Questions About Computer and Internet Use," U.S. Census Bureau, available at https://www.census.gov/acs/www/about/why-we-ask-each-question/computer/, accessed 11/13/2023.

as well as for individual states and smaller geographic areas.[261] In each year, I take the share of each state's households that have an internet subscription, as provided by the ACS,[262] and multiply that share by the population of the state in order to estimate the number of persons in each state that have an internet subscription in each year 2013 through 2022. I then perform the same operation for the United States overall in each year from 2013 through 2022. The U.S. Census Bureau has not yet released 2023 ACS data, thus I assume 2023 figures are equal to 2022 figures. Finally, I use this ratio (each state's persons with internet subscriptions versus all Americans with internet subscriptions) and apply it to Google's U.S. display advertising revenue and profit in each year as described above to estimate Google's display advertising revenue and profit associated with each state for the years 2013 through 2023.

95. **Table 1** below presents the results of the methodology described above for each year from 2013 through 2023.

[261] American Community Use Survey Information Guide, U.S. Census Bureau, October 2017, available at https://www.census.gov/content/dam/Census/programs-surveys/acs/about/ACS_Information_Guide.pdf, accessed 11/13/2023.

[262] The ACS includes two types of estimates – 1-year and 5-year. I use the 1-year estimates in years 2013-2019, and 2021-2022. For 2020, I have used 5-year results as 1-year results were not available due to the disruption of the COVID-19 pandemic. *See* "Pandemic Impact on 2020 American Community Survey 1-Year Data," United States Census Bureau, October 27, 2021, available at https://www.census.gov/newsroom/blogs/random-samplings/2021/10/pandemic-impact-on-2020-acs-1-year-data.html, accessed 1/10/2024.

[redacted]

D. I Understand Google Has Committed Numerous Violations of State Deceptive Trade Practice Statutes

96. The Plaintiff States allege that Google has violated the deceptive trade practice statutes of the Plaintiff States through multiple programs aimed at manipulating ad auctions, as well as its related deceptive communications, misrepresentations, and omissions. Below I estimate the number of violations that occurred as a result of the misconduct.[263]

97. In order to count violations, [redacted]

[263] I do not include an estimation of violation counts for the Header Bidding claim.

[264] [redacted]; [redacted]

[redacted] Further, I limit my violation count to those violations associated with the Plaintiff States by applying to my counts the ratio of each Plaintiff State's internet population to that of the United States as a whole, the same ratio described in Section IV.C, above.[266]

98. I have assumed that Google's misconduct indirectly affected all Open Auctions within the assumed period associated with each misconduct.[267] While a specific Google program might not have run on each auction during a given period, the misrepresentations of those targeted auctions as second-price auctions, first-price auctions, or that participants were on equal footing in such auctions, and the inability of publishers and advertisers to determine whether and to what

265 [redacted]

266 [redacted].

267 I have been asked to assume based on Dr. Weinberg's report that all auctions during the period in which RPO, DRSv1, DRSv2, and Bernanke misconducts were active were affected by the claimed misconduct, whether they were directly targeted by the misconduct or not. I further understand that Google represented in 2019 that all participants were on equal footing in AdX auctions; however, this was not true, due to various auction advantages Google gave to Facebook pursuant to the NBA, as well as the impact of First Price Bernanke. *See* Expert Report of Dr. Joshua Gans, June 7, 2024; Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 8.G. These advantages created an uneven playing field in all auctions subsequent to Google's disclosure on its website that: "All participants in the unified auction, including Ad Exchange and third-party exchanges, compete equally for each impression on a net basis." *See* "How Open Bidding Works," Google Ad Manager, November 20, 2019, available at https://web.archive.org/web/20191120001210/https:/support.google.com/admanager/answer/7128958, accessed 5/23/2024; Expert Report of Dr. Joshua Gans, June 7, 2024.

extent Google's programs/conduct applied to a given auction caused publishers and advertisers to behave differently than they would have but for Google's misconduct.[268]

99. **Table 2** below presents a violation count for each of Google's misconducts over the period January 2013 to May 2024 using the methodology for counting violations described above.[269] The violation counts presented in the table below are conservative as I have chosen the full launch date of each auction manipulation as the starting date for counting violations instead of any earlier dates of experimentation, even though I understand that such experiments were run in and impacted live auctions.[270] For example, for RPO, I use March 31, 2015 as the starting date, which Google represents is the date of full RPO launch.[271] For DRS, I use August 20, 2015 as the starting date, which Google represents is the date of DRS v1 launch.[272] For Bernanke, I use November 11, 2013 as the starting date, which is the date Google represented as the full Bernanke

[268] *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 7.F, Section 7.G, Section 8.C, Section 9.B; Expert Report of Dr. John Chandler, June 7, 2024, §X.

[269] [redacted] Further, as I state in this report, I assume that all Open Auctions were affected by Google's misconduct. However, if the trier of fact determines that these estimates are relevant in determining the number of violations, I reserve the right to adjust my violation counts. To note, lowering violation counts would lead to a lower overall penalty than I recommend here, which may not provide adequate deterrence to Google as required by several state's deceptive trade practice statutes.

[270] *See* Expert Report of Dr. John Chandler, June 7, 2024, §X.G.

[271] Defendant Google LLC's First Amended Responses and Objections to Plaintiffs' Third Set of Interrogatories, Responses to Interrogatory No. 6.

[272] Defendant Google LLC's First Amended Responses and Objections to Plaintiffs' Third Set of Interrogatories, Responses to Interrogatory No. 6.

launch date.[273] For Equal Footing/AdX Fairness, I use November 20, 2019 as the starting date, which is the date of the earliest identified widespread representation by Google regarding auction participants competing equally, though as stated above, Google made such representations before that time.[274]

100. [redacted][276] Further, I understand the Plaintiff States are claiming that the miscommunication or lack of communication around these experiments, or the complete concealment thereof, was deceptive such that auction participants were unaware of the experiments, which programs Google was experimenting with, or which auctions were affected by Google's experiments.[277] Thus, although I limit my violation count to post-full launch auctions, I understand that auctions during the earlier experimental phases of the misconducts were also affected, and as a result could be considered violations as well.[278]

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[273] Defendant Google LLC's First Amended Responses and Objections to Plaintiffs' Third Set of Interrogatories, Responses to Interrogatory No. 6; GOOG-DOJ-28386151 at -165 (December 10, 2013 internal Google presentation titled "Project Bernanke" states "Fully launched on 2013-11-11").

[274] "How Open Bidding Works," Google Ad Manager, November 20, 2019, available at **https://web.archive.org/web/20191120001210/https:/support.google.com/admanager/answer/7128958**, accessed 5/23/2024 ("All participants in the unified auction, including Ad Exchange and third-party exchanges, compete equally for each impression on a net basis.").

[275] [redacted] *See also,* Expert Report of Dr. John Chandler, June 7, 2024, §X.G

[276] *See* GOOG-DOJ-15418450; GOOG-AT-MDL-B-001109245; GOOG-DOJ-14265301 at -301-302. *See also,* Expert Report of Dr. John Chandler, June 7, 2024, §X.G.

[277] *See* Expert Report of Dr. John Chandler, June 7, 2024, §X.C, G.

[278] As such, I reserve the right to update my violation counts at a future date if necessary. The data my analysis relies on allows me to adjust the violation count calculation at the monthly level and at the state level. If the trier of fact determines that the period of the misconduct for any claim must be adjusted, my analysis can easily be adapted for such changes. *See* **Exhibit 3** for monthly counts of Open Auctions related to Plaintiff States by each of the misconducts. *See* **Exhibit 4** for annual counts of Open Auctions related to Plaintiff States by each of the misconducts by state. Further, I provide Open Auction violation counts related to certain misconduct broken out into

[redacted]

101. While I provide a violation count of Open Auctions associated with each misconduct in this table, each individual auction should only be counted as one violation. For example, if the trier of fact finds that Google is liable for both RPO and Bernanke, each auction that occurred during the period both misconducts were active should only be counted once as a violation.[279]

E. Potential Penalties Under State Deceptive Trade Practices Statutes Are Between $0 and $25,000 per Violation

102. As I describe in Section III.F above, under each state's deceptive trade practices statute, the trier of fact can assess a range of penalties up to a certain maximum amount per violation. **Table 3** below lists the maximum penalty per violation by state.

subperiods (DRSv1, DRSv2, Second Price Bernanke, and First Price Bernanke) in **Exhibit 5**. *See* **Exhibit 6** for monthly counts of all auctions ("total queries") related to Plaintiff States should the trier of fact find this relevant.

[279] I also understand that Nevada's deceptive trade practices statute allows for an additional violation for deceptive conduct in each auction that adversely impacted a Nevada-based consumer, advertiser or publisher and thus conduct related to one auction could be the basis for multiple violations of Nevada's statute. *See* Nevada Revised Statutes 598.0999, available at **https://www.leg.state.nv.us/nrs/NRS-598.html#NRS598Sec0999**, accessed 4/3/2024; Nevada Revised Statutes 598.0915-598.0925, available at **https://www.leg.state.nv.us/nrs/NRS-598.html#NRS598Sec0999**, accessed 4/3/2024. I conservatively assume that one auction is equivalent to no more than one violation.

Table 3
Maximum Penalty
State Deceptive Trade Practice Statutes

State/Territory	Maximum Penalty per Violation	State/Territory	Maximum Penalty per Violation
Alaska	$ 25,000	Montana	$ 10,000
Arkansas	$ 10,000	Nevada	$ 15,000
Florida	$ 10,000	North Dakota	$ 5,000
Idaho	$ 5,000	Puerto Rico	$ 5,000
Indiana	$ 5,000	South Carolina	$ 5,000
Kentucky	$ 2,000	South Dakota	$ 2,000
Louisiana	$ 5,000	Texas	$ 10,000
Mississippi	$ 10,000	Utah	Uncapped
Missouri	$ 1,000		

Sources: Texas Deceptive Trade Practices Act; Alaska Unfair Trade Practices and Consumer Protection Act; Arkansas Deceptive Trade Practices Act; Florida Deceptive and Unfair Trade; Idaho Consumer Protection Act; Idaho Rules of Consumer Protection; Indiana Deceptive Consumer Sales Act; Practices Act; Kentucky Revised Statutes Chapter 367; Louisiana Unfair Trade Practices and Consumer Protection Law; Mississippi Consumer Protection Act; Missouri's Merchandising Practices Act; Montana's Unfair Trade Practices and Consumer Protection Act; Nevada Deceptive Trade Practices Act; North Dakota Century Code; The Puerto Rico Antitrust Act; South Carolina Unfair Trade Practices Act; South Dakota Codified Laws; Utah Consumer Sales Practices Act.

103. In this section, I present the maximum penalty amount related to Google's misconduct based upon the maximum penalty per violation in each Plaintiff State and the maximum number of violations determined in the previous section.[280] While this figure represents the maximum potential penalty for the alleged misconducts based upon my analysis, it does not necessarily represent the appropriate penalty in this case, which must be determined based on relevant factors. My understanding is that deterrence of future misconduct, the history of past violations, and the economic impact of the penalty on the offending party are all relevant factors to guide a determination of civil penalties related to the misconduct at issue in this matter, although, as noted above there are other factors also relevant to determining the appropriate penalty amounts.

280 [redacted].

In subsequent sections, I analyze these three factors and present my conclusions on the appropriate penalty per violation based upon my analysis.

104. Using the maximum potential penalty for each Plaintiff State and the maximum violation count related to Google's misconduct as determined in the previous section, I find that the maximum total penalty is [redacted][281]

105. The remainder of my report will put this potential penalty into context and provide the trier of fact with information to assist in their determination of the appropriate penalty per violation in accordance with relevant factors I have analyzed.

F. Amount Necessary to Deter Future Violations

106. From a financial and economic perspective, to deter future violations, the total penalty must eliminate Google's financial incentive to engage in the alleged misconduct. If it remains beneficial for Google to engage in the misconduct after paying a penalty, Google will retain a financial incentive to continue engaging in the misconduct and simply view the penalty as a cost of doing business.[282] One way to frame the appropriate amount to deter future bad behavior is to consider an approach that penalizes Google for at least the benefits it gained associated with the alleged misconduct. However, there are three issues to note with this approach.

107. First, while the Plaintiff States' deceptive trade practices statutes have caps on the amount of the penalty per violation, these statutes do not limit the penalty amount to the financial

[281] Utah's penalty per violation is uncapped. For the purposes of this calculation, I use $2,500 penalty per violation for Utah, which I understand is the maximum penalty for administrative proceedings in Utah.
[282] *See also,* Carolyn Carter, Consumer Protection in the States: A 50-State Evaluation of Unfair and Deceptive Trade Practices Laws, National Consumer Law Center, March 2018, at p. 30, available at **https://www.nclc.org/wp-content/uploads/2022/09/UDAP_rpt.pdf**, accessed 6/4/2024. ("In almost all states, the UDAP statute allows the state to ask a court to impose a monetary penalty on a business that has engaged in an unfair or deceptive practice. A substantial civil penalty for initial violations is important because of its deterrent effect. A business that faces no potential penalty beyond returning its ill-gotten gains may be tempted to engage in unfair and deceptive practices. If it is caught, it simply ends up back where it started, but if not caught it keeps its gains. The potential of a civil penalty in addition to restitution helps balance this equation.")

benefits from the misconduct. Therefore, the penalty amount per violation can exceed the amount of financial benefit generated by the misconduct, as long as the penalty amount is within the penalty cap specified in each Plaintiff State's deceptive trade practices statute. Second, if the defendant may continue to enjoy future benefits from the alleged misconduct, the historical benefits may not capture the total benefit from the misconduct. Limiting the penalty only to historical benefit in such cases would fail to deter future violations because the misconduct would still be beneficial. Third, even a penalty equal to the entire amount of financial benefit from the alleged misconduct may be insufficient to completely eliminate a defendant's financial incentive to engage in future misconduct. This is because if the penalty amount is limited to only the amount of the historical financial benefits associated with the misconduct, the expected value of engaging in future misconduct may still be positive if a defendant perceives that there is a less than 100 percent probability that it will be caught and found liable for future misconduct and/or perceives some other ancillary, indirect, or intangible benefit by engaging in the misconduct.

108. I understand that several statutes allow for trebling damages to establish deterrence of future misconduct.[283] From an economic perspective, trebling damages removes the financial incentive to engage in the misconduct because it allows for the fact that the defendant may continue

[283] Specifically, I understand that U.S. statutes, like the Clayton Act, the Racketeer Influenced and Corrupt Organizations Act ("RICO"), and 35 U.S. Code § 271 (which governs patent infringement claims), require or allow for a trebling of damages under certain circumstances for civil claims in addition to any criminal sanctions that may be applicable. It is recognized that "[t]he purposes of trebling damages is twofold: to compensate plaintiffs for their injury and to *deter future violations*." (emphasis added). *See* 15 U.S. Code § 15; 18 U.S. Code § 1964; 35 U.S. Code § 284; J. Gregory Sidak, Rethinking Antitrust Damages, 33 STAN. L. REV. 329, 330 (1981), available at https://www.criterioneconomics.com/docs/rethinking_antitrust_damages1.pdf; *Halo Electronics, Inc. v. Pulse Electronics, Inc.* 579 U.S. (2016).; "Congress modeled RICO's treble damage provision, section 1964(c), after the antitrust treble damage provision[…] of the Clayton Act. Congress did this to reflect the necessary remedial scheme that would 'curtail-and eventually. . . eradicate the vast expansion of organized crime's economic power,'" per Judith A. Morse, Treble Damages under RICO: Characterization and Computation, 61 Notre Dame L. Rev. 526 (1986).

benefitting from the misconduct in the future; and (b) if the defendant engages in future misconduct, the probability that the defendant is found liable is typically less than 100 percent.

109. While I understand that each of Google's misconducts alleged in this matter are deceptive and misleading in their own right and directly benefit Google, collectively, I understand that they also provide Google with certain indirect benefits that may help enable Google to engage in anticompetitive conduct and build and maintain market share across the display advertising industry.[284] Below I first describe the direct and indirect benefits from the alleged misconduct, and then quantify estimates of these benefits based on available information.

i. Google Derives Direct and Indirect Benefits from the Alleged Misconduct

110. Google directly benefits from its misconduct every time an auction clears on AdX that would not have cleared but-for the misconduct, or if the clearing price was higher than it would have been absent the misconduct.[285] For example, each time an auction cleared in AdX because

[284] I understand that Dr. Gans will further opine on Google's anticompetitive behavior and its effects in his report.
[285] There are documents in the record that provide estimates of the direct monetary impact related to Google's misconduct. When asked to provide "Google's revenue and profits attributable to such Google Auction Mechanic" Google has stated that [redacted] Further, as I describe herein, Google's benefit from the misconduct is not limited to the direct monetary benefit of each misconduct.

[redacted]

[redacted]

Google used DRS to adjust its take rate, Google directly benefited because it earned a fee that it would not have earned without employing DRS. Similarly, each time the clearing price of an auction was higher than it would have been but for Google's use of RPO, Google directly benefited because its fees are set as a percentage of the auction price. Therefore, the higher the clearing price, the higher Google's fee.

111. But these direct benefits are not the only way Google derived benefits from the alleged misconduct. Google also derived indirect benefits from the misconduct. These include obtaining funds that can be used for additional employees, to improve their technology, or to improve its relative position in the industry, including by funding acquisitions. Google's benefits related to the misconduct are also enhanced by other factors.

112. Since Google entered the display advertising space in 2003 with AdSense,[286] the company has steadily increased its presence in the industry, both in terms of size and scale. What started as a tool to help publishers monetize website space now includes large and small advertiser (buy-side) tools, publisher (sell-side) tools including publisher ad servers, as well as the ad exchange to intermediate between the two sides of the display advertising platform.[287] Not only has Google's scope expanded to cover all aspects of the display ad ecosystem, but in each portion of the stack Google has grown and its tools now dominate.[288] Economic analysis shows that

[redacted]

[redacted]

286 "Google Expands Advertising Monetization Program for Websites," Google Blog, June 18, 2003, available at **https://googlepress.blogspot.com/2003/06/google-expands-advertising-monetization.html**.
287 Expert Report of Dr. Joshua Gans, June 7, 2024, Section III.A.
288 Expert Report of Dr. Joshua Gans, June 7, 2024, Sections V.C, V.D, V.E.

Google accounts for 40 to 90 percent of each segment of the display advertising market.[289] This market positioning is attributable, in part, to the indirect benefits Google has gained from the deceptive trade practices and antitrust misconduct at issue in this matter.

113. Three major acquisitions helped Google position itself for dominance in the display advertising space: DoubleClick in 2008, Invite Media in 2010, and AdMeld in 2011.[290] Google leveraged its significant assets in each case to make the acquisitions, buying DoubleClick for $3.1 billion, Invite Media for $81 million, and AdMeld for $400 million.[291] In each instance Google acquired a technology to bolster its own offerings and eliminated a potential alternative.[292] For example, in 2010, shortly after the DoubleClick acquisition, Google launched the Google Display Network ("GDN") saying "[o]ver the past year, we've been focused on investing in display advertising, and we've seen great momentum from the increasing number of you running display campaigns with Google …To provide more places for you to run display ads, we've added more publisher sites (through Google AdSense and DoubleClick Ad Exchange) to our ad network of over one million sites … In an effort to make our display media offerings clearer to advertisers like you and agencies, we're creating a new umbrella name for all these properties, the Google Display Network."[293] Additionally, I understand that Google has benefitted from indirect network

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[289] *How Three Mergers Buttressed Google's Ad Tech Monopoly, Per DOJ*, Tech Policy Press (March 9, 2023), **https://www.techpolicy.press/how-three-mergers-buttressed-googles-ad-tech-monopoly-per-doj/**. *See also* Expert Report of Dr. Joshua Gans, June 7, 2024, Sections V.C, V.D, V.E.

[290] *How Three Mergers Buttressed Google's Ad Tech Monopoly, Per DOJ*, Tech Policy Press (March 9, 2023), **https://www.techpolicy.press/how-three-mergers-buttressed-googles-ad-tech-monopoly-per-doj/**.

[291] "Google Buys DoubleClick for $3.1 Billion," New York Times, April 14, 2007, available at **https://www.nytimes.com/2007/04/14/technology/14DoubleClick.html**; "Google's Final Price Tag for Invite Media: $81 Million," All Things D, June 9, 2010, available at **https://allthingsd.com/20100609/googles-final-price-tag-for-invite-media-81-million/**, accessed 6/3/2024; "Google Acquires AdMeld For $400 Million," TechCrunch, June 9, 2011, available at **https://techcrunch.com/2011/06/09/google-acquires-admeld-for-400-million/**.

[292] *How Three Mergers Buttressed Google's Ad Tech Monopoly, Per DOJ*, Tech Policy Press (March 9, 2023), **https://www.techpolicy.press/how-three-mergers-buttressed-googles-ad-tech-monopoly-per-doj/**.

[293] "Introducing the Google Display Network," Google Blog, June 18, 2010, available at **https://adwords.googleblog.com/2010/06/introducing-google-display-network.html**, accessed 5/15/2024.

effects that exist in the ad exchange market.[294] As Dr. Gans explains in his report, network effects occur when the value of a product or service increases as more people use it, creating a positive feedback loop.[295] Those firms that are able to achieve scale in a market characterized by indirect network effects reap advantages, including creating high entry barriers for competitors.[296] I understand that Dr. Weinberg has opined that the benefit to Google from RPO, DRS and Project Bernanke could include increased AdX win rates and revenue, as well as decreased win rates and revenues for non-AdX exchanges.[297] The increased AdX win rates result in attracting more publishers and advertisers to Google's platform, while decreased win rates and revenues for non-AdX result in decreased competition.[298] As such, Google will continue to benefit from the alleged misconduct in the future due to its improperly enhanced position.

114. Finally, I understand that Plaintiff States' allegations in this case include antitrust claims in addition to the deceptive trade practices claims. While separate and distinct, these allegations relate in some ways to the same type of conduct (for example, Project Bernanke) and in the sense that each type of misconduct has the ability to enhance the other. For example, Dr. Gans concludes that Google's DFP and Google's AdX have monopoly power in their respective

[294] Expert Report of Dr. Joshua Gans, June 7, 2024, Section V.D.
[295] Expert Report of Dr. Joshua Gans, June 7, 2024, Section V.D.
[296] Expert Report of Dr. Joshua Gans, June 7, 2024, Section V.D.
[297] Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 7.E; Section 8.F, Section 9.C. I note that Dr. Weinberg observes that the effect of RPO on the AdX win rate may be ambiguous as it depends on the effectiveness of the program because RPO has certain offsetting factors on auction win rates. However, according to Dr. Weinberg, it is reasonable to expect Google, a sophisticated seller with access to significant amounts of data, to be able to achieve this. *See* Expert Report of Dr. Matthew Weinberg, June 7, 2024, Section 9.C. Google documents indicate Dr. Weinberg's intuition is correct. [redacted]
[298] Expert Report of Dr. Joshua Gans, June 7, 2024, Section V.D. ("Higher match rates, broader reach, and high-paying ads make an established ad exchange more attractive to both types of participants, reinforcing the network effects").

relevant markets,[299] and further that publishers are locked in to using the DFP ad server.[300] Thus Google's deceptive misconduct affecting DFP publishers on AdX is enhanced because of publisher difficulty in leaving the platform – they cannot easily switch to a non-deceptive competitor. As I explain above, due to indirect network effects, increased AdX win rates and revenue from the deceptive misconduct results in attracting more publishers and advertisers to Google's platform, furthering Google's monopoly position. Hence, each type of alleged conduct reinforces the other.

115. The deceptive misconduct alleged in this matter is thus properly viewed as part of an overall scheme by Google to dominate and maintain its place in the display advertising industry using various levers at its disposal, including the misconduct at issue. Google gained both direct and indirect benefits as a result of its misconduct.

ii. Quantification of Google's Benefits

116. Ideally, Google's benefits from the alleged misconduct should be measured as the incremental benefits it obtained by engaging in the misconduct. Such an analysis is commonly referred to as a "but for" analysis and involves comparing Google's actual financial position given the misconduct that occurred (including past profits, market position, and expected future profits), to the financial position Google would have been in but for the misconduct. The concept of a "but-for" analysis is well established in the context of quantifying damages and other forms of monetary relief, and therefore, is instructive in determining how such analyses should be performed for the purposes of determining statutory penalties as well. For example, unjust enrichment, a form of monetary relief, is measured as the difference between the profits that the defendant actually

[299] Dr. Gans states that "Google's DFP has monopoly power in the market for publisher ad servers for selling open web display advertising space" and that "AdX has monopoly power in the market for ad exchanges for transacting indirect open web display advertising." *See* Expert Report of Dr. Joshua Gans, June 7, 2024, Sections V.C, V.D.
[300] Expert Report of Dr. Joshua Gans, June 7, 2024, Section VI.

earned and the profits they would have earned but for the misconduct.[301] Similarly, lost profit damages are measured as the difference between the profits that the plaintiff would have earned but for the misconduct and the profits it did earn given that the misconduct that occurred.[302] As yet another example, diminution in business value damages are measured as the difference between the value of the plaintiff's business but for the misconduct and its value given the misconduct that occurred.[303] Because value is based on expected future earnings, such an analysis takes into account the differences in the injured party's market position and the expected future benefits from the market position.

117. Unfortunately, the information required to perform such an analysis in this case is currently not available. I understand that the Plaintiff States have issued requests for information related to the number of impressions affected by certain Google programs at issue in this litigation (including RPO, DRS and Project Bernanke), Google revenue and profits attributable to these programs, and any additional value gained by Google related to these programs. However, to date, that information has not been produced by Google. Instead, [redacted], a software engineer at Google, submitted a declaration on May 24, 2024 responding to Plaintiff States' requests in which he stated that: [redacted]

[301] Boushie, Kristopher A., et al. *Calculating and Proving Damages*. Law Journal Press, 2011, §1.04[1] at 1-9, §9.10[1] at 9-40.
[302] Boushie, Kristopher A., et al. *Calculating and Proving Damages*. Law Journal Press, 2011, §1.04[1] at 1-7., §9.09[1] at 9-34; Weil, Roman L. et al. *Litigation Services Handbook The Role of the Financial Expert*, John Wiley & Sons, Inc. 2012, Fifth Edition, 4.8.
[303] Boushie, Kristopher A., et al. *Calculating and Proving Damages*. Law Journal Press, 2011, §1.04[1] at 1-9.; Weil, Roman L. et al. *Litigation Services Handbook The Role of the Financial Expert*, John Wiley & Sons, Inc. 2012, Fifth Edition, 4.x.

[redacted][304]

118. As such, to date, Google has not produced information relevant and necessary to quantify the direct benefits, much less the indirect benefits from the alleged misconduct. Given the interconnectedness of the misconduct and the lack of information and data produced to date, I am unable to determine Google's financial benefit absent the misconduct, and therefore, cannot determine the incremental benefit to it from engaging in the misconduct. Additionally, I also cannot isolate the profit or revenue associated with each misconduct on its own. In lieu of an incremental benefits analysis, I consider two alternative quantitative measures – Google's display advertising profit and their display advertising revenue – that provide an indication of the aggregate benefit Google has derived during the period in which it engaged in the misconduct.

119. As I show in **Table 1** above, Google's operating profit and revenue associated with its display advertising segment allocable to the Plaintiff States between 2013 and 2023 totaled [redacted] Operating profit measures the income earned from Google's operation of the display segment after paying operating costs, however it does not measure the totality of Google's benefit from its misconduct nor its ability to leverage its gains from this misconduct.

120. For example, [redacted].[305] [redacted]

[304] *See* Declaration of [redacted] in Support of Defendant Google LLC's Responses to Plaintiffs' Third Set of Interrogatories, May 24, 2024. *See also* Defendant Google LLC's First Amended Responses and Objections to Plaintiffs' Third Set of Interrogatories, Responses to Interrogatories 7, 8 and 10.
[305] *See, for example*, GOOG-DOJ-AT-02649870.

[redacted][306]

[redacted][307] [redacted]

This should be considered when accounting for the benefit Google has gained from its display advertising misconduct.

121. Additionally, as I discuss above, Google's ability to grow by acquisition has been critical to its domination of the display advertising ecosystem. Google leveraged its significant assets to buy DoubleClick for $3.1 billion in 2008, Invite Media for $81 million in 2010, and AdMeld for $400 million in 2011.[308] Google's ability to take these actions is key its ability to dominate the display advertising ecosystem. Google's operating profit in display does not adequately represent this benefit to Google's positioning.

122. Finally, Google's past operating profit in the display advertising segment ignores the future gains that Google stands to make by virtue of its misconduct to date. By engaging in the misconduct, Google has benefitted itself to the detriment of competitors and other participants in the display advertising ecosystem and assured that it can continue to do so well into the future.

123. For all of the above reasons, I consider Google's display advertising operating profit allocable to the Plaintiff States to be an inadequate and inappropriate proxy for the overall

[306] GOOG-AT-MDL-002189396 at -403.
[307] GOOG-AT-MDL-004326981 at -005.
[308] How Three Mergers Buttressed Google's Ad Tech Monopoly, Per DOJ, Tech Policy Press (March 9, 2023), **https://www.techpolicy.press/how-three-mergers-buttressed-googles-ad-tech-monopoly-per-doj/**.

benefit, both direct and indirect, that Google has gained from the misconduct. For this reason, I also consider Google's display advertising revenue allocable to the Plaintiff States as a consideration when assessing the total penalty necessary to eliminate Google's financial incentive to engage in the alleged misconduct.

G. The History of Previous Violations

124. In addition to the amount necessary to deter misconduct, I also considered Google's history of previous violations, which I understand is an additional relevant factor in determining a civil penalty. My understanding is that this factor takes into account the track record of settlements and fines that the alleged wrongdoer has incurred in the past as relevant to the trier of fact in determining an appropriate penalty.

125. Google has paid numerous fines and settlements related to various alleged misconduct. [redacted], Google also settled litigation in California in September 2023 related to alleged improper tracking of user location data for $93 million.[310] Google also settled litigation in California in early 2024 related to alleged improper tracking of users in Chrome's Incognito mode.[311] Though this settlement included only injunctive relief, that relief was valued at more than $5 billion and individual plaintiffs may still bring suit for damages.[312]

309 [redacted]
310 "Google to pay $155 million in settlements over location tracking," Reuters, September 15, 2023, available at https://www.reuters.com/legal/google-pay-155-million-settlements-over-location-tracking-2023-09-15/, accessed 5/29/2024.
311 *Brown et al. v. Google LLC*, Plaintiffs' Unopposed Motion for Final Approval of Class Action Settlement, April 1, 2024.
312 *Brown et al. v. Google LLC*, Plaintiffs' Unopposed Motion for Final Approval of Class Action Settlement, April 1, 2024.

126. This information is relevant here because, although Google has been forced to pay [redacted] for various misconduct over the past several years, these monetary penalties have not proven to be detrimental to Google, and in fact in total represent [redacted].[313] These penalties have also been insufficient as a method to deter Google's various misconduct, which I understand is ongoing according to the petition in this matter.[314] A jury considering the appropriate amount of penalties should weigh this information when contemplating Google's misconduct and the sufficient penalty to deter future misconduct.

H. The Trier of Fact Should Award Deceptive Trade Practice Penalties in the Range of [redacted]

127. **Table 4** below presents a range of total penalties associated with each misconduct based on my violation counts above and a range of per violation penalties [redacted].[315]

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[313] [redacted]

[314] *See, for example*, Complaint at ¶¶587, 589.

[315] [redacted]

[redacted]

128. Based upon the information available to me as of today, the analysis presented in this report, as well as my education, training and experience, I conclude that it would be reasonable and appropriate for the trier of fact to assess a penalty [redacted].[316]

129. In line with the deceptive trade practice factors that I discuss in detail above, these levels of penalties could have a sufficiently meaningful impact on Google's financial position to act as a deterrence of future violations but would not be so burdensome as to impact the day-to-day operations of the company or bankrupt Google, which I discuss in the next section.

130. Assessing this level of penalty per violation would result in a maximum of $21.81 billion in total penalties. The maximum represents total penalties if the trier of fact determined that penalties should only be assessed on the Bernanke claim covering the period November 2013 to present. The maximum also represents the cap on penalties if the trier of fact determines that

[316] I understand that Alaska's AUTPCPA references a minimum civil penalty of $1,000 per violation. While I do not include a $1,000 minimum penalty per violation in my calculations, the tier of fact may multiply the number of violations I calculate in this report by the minimum penalty amount consistent with the AUTPCPA in assessing the total penalty amount.

penalties should be assessed to cover all claims as this figure is based on the total Open Auctions during this period and each auction should only be counted once as a violation.[317]

I. The Economic Effect on the Person Against Whom the Penalty is to be Assessed

131. I also understand that the economic effect of a penalty on Google is a relevant factor for the trier of fact in its determination of a penalty. There are several metrics and ratios that financial analysts use to evaluate the economic and financial condition of a company. Some key areas analysts usually focus on include a company's profitability, assets, and cash flows. Analysts sometimes have preferences of certain metrics and ratios versus others but there is not a set of metrics or ratios that will capture the full information set of a company. Below I will show the impact on Google from paying a total civil penalty of $29.08 billion on its profitability, assets, and cash flow by using some common financial metrics and ratios. This is the maximum penalty I show in **Table 4** above. As I discuss below, a total penalty of $29.08 billion would have a sufficiently meaningful impact on Google's financial position to deter future violations but would not be so burdensome as to impact the day-to-day operations of the company or bankrupt Google. While the trier of fact may choose to assess a lower penalty, the economic impact on Google of a lower penalty would also be lower.

i. Impact on Profitability

132. Google will record any civil penalty imposed as a general and administrative expense.[318] As such, Google's operating expenses for the period of the penalty will increase and its profitability will decrease. EBIT (Earnings Before Interest and Taxes), EBITDA (Earnings Before Interest, Taxes, Depreciation, and Amortization), Net Income, and Earnings per Share are

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[317] I provide total penalties related to certain misconduct broken out into subperiods (DRSv1, DRSv2, Second Price Bernanke, and First Price Bernanke) in **Exhibit 7.**

[318] *See* Alphabet Inc. 10-K Year Ended December 31, 2023, pp. 77-78.

all common measures analysts use to assess a company's profitability. I describe their uses briefly below:

- EBIT serves as a measure of a company's profitability from its core business before the impact of its capital structure choices and tax treatments.
- EBITDA, which is EBIT plus Depreciation and Amortization serves as a proxy for operating cash flow as Depreciation and Amortization are non-cash expenses.
- Net Income is the earnings of a company, its bottom line, or profit. Compared to EBIT, it deducts both interest and tax expenses as well as adding non-core income and subtracting non-core expenses. Net Income is earnings available for the equity holders of the company.
- Earnings per share is calculated as $\frac{\text{Net Income}}{\text{Shares Outstanding}}$. It is often used by analysts and investors for estimating a company's value as investors will pay more for higher earnings per share value.

133. Additionally, profit margins can be calculated by dividing each of EBIT, EBITDA, and Net Income by Total Revenue. Profit margins indicate how efficient a company uses its assets and manages its operations.[319] All else equal, higher profit margins are desired.[320]

134. In **Table 5** below, I show Google's fiscal year 2023 EBIT, EBITDA, Net Income, Earnings per Share, and profit margins from 2013 through 2023 before and after a $29.08 billion civil penalty.

[319] Ross, Westerfield, Bradford, *Fundamentals of Corporate Finance* McGraw-Hill Irwin, 9th edition, p. 61.
[320] Ross, Westerfield, Bradford, *Fundamental of Corporate Finance* McGraw-Hill Irwin, 9th edition, p. 62.

Table 5[321]
Profitability Metrics
For the Year Ended December 31, 2023

(in millions)					Margins		
Penalty	**EBIT**	**EBITDA**	**Net Income[A]**	**Earnings per Share[B]**	**EBIT**	**EBITDA**	**Net Income**
None	$88,226	$100,172	$73,795	$5.80	28.7%	32.6%	24.0%
$29,076	$59,150	$71,096	$44,719	$3.51	19.2%	23.1%	14.5%
% Change	*-33.0%*	*-29.0%*	*-39.4%*	*-39.4%*	*-33.0%*	*-29.0%*	*-39.4%*

Notes:
[A] Per I.R.C. § 162(f), no deduction otherwise allowable shall be allowed for any amount paid or incurred (whether by suit, agreement, or otherwise) to, or at the direction of, a government or governmental entities in relation to the violation of any law or the investigation or inquiry by such government or entity into the potential violation of any law.
[B] Diluted Earnings per Share. Presented in actual dollar amounts.
Sources: Alphabet Inc. Form 10-K for the fiscal year ended December 31, 2023; S&P Capital IQ.

135. A $29.08 billion penalty results in a significant but limited decrease of 29.0% to EBITDA and 39.4% to Net Income and Earnings per share.

ii. Impact on Assets

136. Google will be paying any civil penalties imposed with cash. This civil penalty payment will decrease Google's cash asset balance and its overall asset balance. Cash and cash equivalents are classified in a category of assets called current assets. Current assets are assets on the balance sheet that are expected to convert to cash within a year and are considered liquid assets.[322] Cash and cash equivalents are a company's most liquid assets.[323] Examples of other current assets typically include accounts receivable, inventory, and marketable securities.

137. Current assets are important for a company's short-term liquidity and solvency and are used in calculating ratios known as short-term solvency ratios or liquidity ratios. Liquidity ratios are a measure of a company's short-term liquidity and are important to its short-term

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[321] S&P Capital IQ.
[322] Ross, Westerfield, Bradford, *Fundamental of Corporate Finance* McGraw-Hill Irwin, 9th edition, p. 20.
[323] Brealey, Richard A., Myers, Stewart C., and Allen, Franklin, *Principles of Corporate Finance*, McGraw-Hill/Irwin, Tenth Edition: 2011, p. 719.

creditors.[324] Some widely used liquidity ratios are the current ratio and the cash ratio. I describe each of these liquidity ratios briefly below.

- The current ratio is calculated as $\frac{\text{Current Assets}}{\text{Current Liabilites}}$.[325] The current ratio shows a company's ability to pay its short-term liabilities on time.[326] A healthy company's current ratio is expected to be at least 1 indicating that current assets are greater than current liabilities.[327]
- The cash ratio is calculated as $\frac{\text{Cash+ Cash Equivalents}}{\text{Current Liabilites}}$. Because a company's most liquid assets are its holdings of cash,[328] the cash ratio shows a company's ability to meet its current liabilities with only its cash and cash equivalents. The cash ratio is more conservative than the current ratio.

138. In general, higher liquidity ratios are preferred.[329] In **Table 6** below, I show Google's Cash balance, Current Asset balance, Asset balance, and liquidity ratios as of the end of 2023 before and after a civil penalty of $29.08 billion is assessed.

[324] Ross, Westerfield, Bradford, *Fundamental of Corporate Finance* McGraw-Hill Irwin, 9th edition, p. 55.
[325] Ross, Westerfield, Bradford, *Fundamental of Corporate Finance* McGraw-Hill Irwin, 9th edition, p. 55.
[326] Pratt, Reilly, Schweihs, *Valuing a Business*, McGraw-Hill Irwin, Third Edition: 1996, p. 130.
[327] Ross, Westerfield, Bradford, *Fundamental of Corporate Finance* McGraw-Hill Irwin, 9th edition, p. 56.
[328] Brealey, Richard A., Myers, Stewart C., and Allen, Franklin, *Principles of Corporate Finance*, McGraw-Hill/Irwin, Tenth Edition: 2011, p. 719.
[329] Liquidity ratios that are too high may indicate an inefficient use of current assets. *See* Ross, Westerfield, Bradford, *Fundamental of Corporate Finance* McGraw-Hill Irwin, 9th edition, p. 56.

Table 6[330]
Impact on Assets and Liquidity Ratios
For the Year Ended March 31, 2024

(in millions)				Liquidity Ratios	
Penalty	**Cash & Cash Equivalents**	**Current Assets**	**Total Assets**	**Current Ratio[A]**	**Cash Ratio[B]**
None	$24,493	$165,471	$407,350	2.15	0.32
$29,076	$0	$136,395	$378,274	1.77	0.00
% Change	*-100.0%*	*-17.6%*	*-7.1%*	*-17.6%*	*-100.0%*

Notes:
[A] Current Ratio = (Current Assets) / (Current Liabilities)
[B] Cash Ratio = (Cash & Cash Equivalents) / (Current Liabilities)
Source: Alphabet Inc. Form 10-Q for the quarterly period ended March 31, 2024.

139. While a $29.08 billion penalty exceeds Google's Cash and Cash Equivalents balance of $24.43 billion as of March 31, 2024, Google also holds $83.60 billion in Marketable Securities as of that date.[331] Marketable securities are extremely liquid assets that can be used to pay a $29.08 billion penalty and/or to provide Google with sufficient cash for normal operations without liquidating other assets or seeking external financing. Indeed, Google's recently announced $70 billion share repurchase authorization also exceeds its available Cash and Cash Equivalents balance and will likely be funded by liquidating its Marketable Securities. Overall, while a $29.08 billion penalty would reduce Google's total assets and current assets base, as well as its current ratio, it would not cause Google any operational challenges, liquidity needs, or solvency concerns. This is evidenced by Google's decision to authorize a $70 billion share repurchase program. This indicates that Google has already determined that it can continue operating even with a $70 billion reduction in its current assets. If needed, it can pause, delay or

330 *See* Alphabet Inc. Form 10-Q for the quarterly period ended March 31, 2024, p. 5.
331 *See* Alphabet Inc. Form 10-Q for the quarterly period ended March 31, 2024, p. 5.

reduce its share repurchases to pay the penalty assessed in this case and avoid any impact to its business greater than what it has already determined is acceptable.

iii. Impact on Cash Flow

140. Cash flows measure the difference between cash inflow and cash outflow of a company over a period of time.[332] Operating cash flow is the cash flow that results from the company's day-to-day activities of producing and selling its products. Analysts are interested in operating cash flow as it generally indicates whether a firm's cash inflows from its business operations are sufficient to cover its cash outflows. Negative operating cash flows are considered undesirable and could be a sign of trouble.[333] Because Google will pay any civil penalties with cash, its operating cash flow for the period of the penalty will be reduced. In **Table 7** below, I show Google's fiscal year 2023 operating cash flow before and after a $29.08 billion civil penalty is assessed.

Table 7[334]
Operating Cash Flow For the Year Ended December 31, 2023

(in millions)	
Penalty	**Operating Cash Flow**
None	$101,746
$29,076	$72,670
% Change	*-28.6%*

Source: Alphabet Inc. 10-K for the fiscal year ended December 31, 2023.

141. Google's operating cash flows for 2023 are positive and will remain positive after a $29.08 billion penalty. This penalty will only reduce Google's operating cash flow by 28.6% and will not have any significant effect on Google's ability to conduct day to day operations.

[332] Ross, Westerfield, Bradford, *Fundamental of Corporate Finance* McGraw-Hill Irwin, 9th edition, pp. 30-31.
[333] Ross, Westerfield, Bradford, *Fundamental of Corporate Finance* McGraw-Hill Irwin, 9th edition, p. 32.
[334] *See* Alphabet Inc. 10-K for the fiscal year ended December 31, 2023, p. 55.

Dated,

June 7, 2024

Jeffrey Andrien

Jeffrey S. Andrien

Coherent Economics

5918 W. Courtyard Drive | Suite 250 | Austin, TX 78730

JEFFREY S. ANDRIEN

Senior Managing Director

EDUCATION

THE UNIVERSITY OF TEXAS AT AUSTIN, McCombs School of Business, Austin, TX
M.B.A.

THE UNIVERSITY OF TEXAS AT AUSTIN, Austin, TX
B.A., Economics

PRESENT POSITION

COHERENT ECONOMICS, Austin, TX.
Senior Managing Director, 2021–Present

PROFESSIONAL EXPERIENCE

THE CLARO GROUP, Austin, TX
Managing Director, 2013–2021

FINANCE SCHOLARS GROUP, Austin, TX
President, 2009–2013
Director, 2008–2009

CRA INTERNATIONAL
Vice President, 2007–2008

ERS GROUP
Principal, 2004-2007

LECG (and predecessor companies)
Senior Engagement Manager, 1998-2004

TEACHING EXPERIENCE

The University of Texas, McCombs School of Business – Lecturer in the Finance Department (Jan 2020 - present). Teaching the core undergraduate Business Finance course. Also teach applied graduate-level finance class.

Thammasat University, Masters-in-Marketing Program – Visiting Professor of Finance and Economics (2006 – 2018). Taught graduate-level course on Marketing Profitability and Intangible Asset Valuation. Member, MIM Admissions Committee.

The University of Texas, McCombs School of Business – Adjunct Professor of Marketing in the MBA Program (Spring 2012). Taught graduate course on managing a global enterprise.

The University of Texas School of Law - Guest Lecturer: Capital Budgeting and Valuation (January 31, 2011), Economics Damages (April 4, 2011).

Washington University in St. Louis, Olin School of Business – Visiting Lecturer (Summer 2008). Taught MBA course on Marketing Profitability and Intangible Asset Valuation.

Vanderbilt University, Owen School of Business – Guest Lecturer in EMBA Program: Brand Valuation (Fall 2008).

ASSOCIATIONS AND MEMBERSHIPS

Customer Experience Certificate Advisory Board, University of Houston, Bauer School of Business, Board Member 2020-2022

University of Texas MSF Advisory Board, McCombs School of Business, Board Member 2014-2021

Thammasat University Masters-in-Marketing (MIM) Admissions Committee 2012-2019

American Bar Association, Associate Member

American Intellectual Property Law Association, Member; Patent Damages Subcommittee, Member; Trademark Litigation Committee, Member.

Austin Intellectual Property Law Association, Member

International Trademark Association, Former Member

Rice University Career Advisory Board (Former Member)

Austin Youth Hockey Association (Former Board Member)

PUBLICATIONS AND PRESENTATIONS

“Lessons from the Trenches: Damages Experts,” CLE presentation and accompanying article for the Texas Bar Association’s Advanced Intellectual Property Law course (February 2019). Article co-authored with Chris Bakewell and Leisa Peschel.

"Patent Damages 101," coordinator and panelist for CLE presentation at the AIPLA's 2016 Annual Meeting (October 2016).

"U.S Shale Play Development ," CLE presentation to Haynes Boone, Beck Redden, and K&L Gates (All done in 2015).

Valuation expert in mock trial at the *Forensic Finance: Better Bankruptcies Through Better Numbers* Conference in Austin, Texas on September 9, 2015.

"*Brand Imperative: Protecting Your Most Valuable Asset"* (with Benoit and Zerrillo), The Future of Branding, Sage Publications, 2016.

"The Four Stages of Lead Partner Relationship Development" (with Chris Paskach), Claro Newsletter, Summer 2015.

"The Evolution of Trademark Litigation Related to Keyword Searches" (with Prateek Shah), Claro Newsletter, Spring 2015.

"*Protecting Intellectual Assets ,"* Presentation at Singapore Management University, February 2015.

"Protecting an Asian Treasure," Asian Management Insights, Vol. 1 Issue 2, November 2014.

"Principles of Business Valuation," CLE presentation to Jones Day in 2015, Nixon Peabody in 2014, Brown McCarroll in 2007, AYLA in 2007, and DYLA in 2007.

"Consumer-Based Conjoint Analysis," CLE presentation to Covington Burling, November, 2013.

"Brand Valuation," Presentation to the Leading Brands Club of Vietnam, Ho Chi Minh City, Vietnam, March 2010.

"Approaches to Brand Valuation in a Global Marketplace," Presentation at the American Intellectual Property Lawyer's Midwinter Meeting, Miami, FL, January 2009.

"Sub-Prime Crisis: How Did We Get Here and What Comes Next? " CLE Presentations to Vinson & Elkins, Winstead, Brown McCarroll, and Fulbright and Jaworski (all done in 2008).

"Working with Financial Experts," CLE presentation to Greenberg Traurig, 2007.

"Understanding Financial Statements," CLE presentation to Hunton and Williams, 2006.

"Lessons from the Trenches: Damages Experts," panelist at the Texas Bar Association's 32nd Annual Advanced Intellectual Property Law Course, Dallas, TX, February 2019. Co-authored article related to topic for the course materials.

Taught Brand Valuation seminar to employees of Universal Robina (Filipino food company), July 31, 2020.

TESTIMONY AND EXPERT REPORTS

Betsy Aubrey et al. v. DOBI Medical International, Inc., et al.
Civil Action No.: A-05-CA-1070-SS. Western District of Texas, Austin Division. Issued Federal Rule 26 report and deposition testimony. 10b-5 Damages case.(2007)

Giddy Up, LLC v. Prism Graphics, Inc. et al.
Civil Action No.: 3:06-CV-0948-BECF. Northern District of Texas, Dallas Division. Issued Federal Rule 26 report and trial testimony related to intellectual property damages. (2007)

Marquis Furniture, Inc. v. Mathis Bros. Furniture Co., Inc., et al.
Case No. CIV-04-1604-F; USDC Western District of Oklahoma. Issued Federal Rule 26 report, Antitrust damages related to price discrimination. (2008)

CenterPoint Energy 2010 Rate Case
Public Utility Commission of Texas, Docket No. 38339. Issued written testimony, dated June 30, 2010 and testified at PUC hearing. Testimony related to cost of services. (2010)

Frank H. Migl, et al. v. Watson Pipe, Inc., et al.
Case No: 07-05-20634-cv; in the 25th Judicial District Court, Lavaca Country, Texas. Issued written report, dated June 28, 2010 and testified at deposition. Testimony related to discount rate for damages calculation. (2010)

Stripes, LLC v. Carlson Restaurants Worldwide, Inc. et al.
Case No: 7:11-CV-00019, USDC Southern District of Texas, McAllen Division. Issued Federal Rule 26 Report, dated January 13, 2012 and testified in deposition. Damages related to trademark infringement. (2012)

Dynamis Therapeutics, Inc. v. Alberto Culver International, Inc.
Case No: 09-773-GMS, USDC District of Delaware. Issued Federal Rule 26 Report, dated April 9, 2012 and testified in deposition. Damages related to the alleged breach of contract of a licensing agreement. (2012)

Securities and Exchange Commission v. Oxford Investment Partners, LLC and Walter J. Clarke
File No: 3-14899, SEC Administrative proceeding. Issued valuation report, dated September 4, 2012. (2012)

Keurig, Inc. v. Sturm Foods, Inc.
Case No: 10-841-SLR-MPT, USDC District of Delaware. Issued Federal Rule 26 Reports, dated November 21, 2012 and December 14, 2012. Testified in deposition on December 19, 2012. Damages related to trademark infringement, trade dress infringement, false advertising and unfair competition. (2012)

Memory Lane, Inc. v. Classmates International, Inc., d/b/a Classmates, et al.
Case No: SACV-1100940-JST (MLGx), USDC Central District of California, Southern Division. Issued Federal Rule 26 Report, dated December 26, 2012. Deposed on April 19, 2013. Testified at trial on February 18, 2014. Testimony addressed liability and damages issues related to trademark infringement. (2012)

Bear Ranch, LLC v. Heartbrand Beef, Inc. American Akaushi Association, and Ronald Beeman
Case No: 6:12-cv-14, USDC Southern District of Texas, Victoria Division. Issued Federal Rule 26 reports on April 12, 2013 and November 22, 2013. Deposed on May 14, 2014 and testified at trial on May 27-28, 2014 and September 11, 2014. Valuation of cattle herd and damages related to breach of contract and fraud claims. (2013)

National Financial Partners Corp. v. Paycom Software, et al.
Civil Action No. 14-cv-7424, USDC Northern District of Illinois, Eastern Division. Issued Declaration in opposition of Plaintiff's Motion for Preliminary Injunction on April 20, 2015. Issue related to irreparable harm resulting from alleged trademark infringement. (2015)

Avnet, Inc. and BSP Software, LLC v. Motio, Inc.
Case No. 1:12-cv-02100, USDC Northern District of Illinois, Eastern Division. Issued Federal Rule 26 report on December 16, 2015 and a rebuttal report on February 10, 2016. Deposed on March 15 2016. Damages related to patent infringement in the software industry. (2015)

US Imaging, Inc. v. US Imaging Network, LLC et al.
Cause No. 2015-32810, District Court of Harris County, TX, 80th Judicial District. Filed report on January 11, 2016. Liability and Damages related to trademark infringement in the medical industry. (2016). Provided deposition testimony on October 25, 2016.

TinicumCapital Partners II, L.P., et al. v. Liberman Broadcasting, Inc. et al.
C.A No. 11902-VCL, Court of Chancery of the State of Delaware. Filed report on February 17, 2016 and rebuttal report on February 23, 2016. Deposed on February 28, 2016. Case involved valuing the expected outcomes of the FCC Incentive Spectrum Auction under different participatory strategies. Issues related to irreparable harm and business strategy. (2016)

United States of America v. Michael Marr et al.
Case No. CR-14-00580-PJH, US District Court, Northern District of California, Oakland Division. Filed declaration on March 17, 2016. Case involved analyzing foreclosure

auction results to determine if there was evidence that the auction prices were suppressed as a result of collusive behavior by the defendants. (2016)

Linda Suchanek, et al. v. Sturm Foods Inc., and Treehouse Foods, Inc.
Case No. 3:11-cv-00565-NJR-PMF, US District Court, Southern District of Illinois. Filed Expert Report on April 28, 2016. Deposed on May 24, 2016. Case involved analyzing damages issues in a class action lawsuit alleging false advertising in the single-serve instant and micro-ground coffee industry. (2016)

Surgiquest, Inc. v. Lexion Medical, LLC
Case No. 14-cv-0382-GMS, US District Court for the District of Delaware. Filed Expert Report on June 24, 2016. Case involved analyzing damages resulting from false and misleading advertising in the market for medical devices for laparoscopic surgery. rovided deposition testimony on November 3, 2016, and trial testimony on April 6, 2017.

Natural Dynamics, LLC. v. Calm Natural Limited, et al.
Case No. 14-cv-0382-GMS, US District Court for the Western District of Texas, Austin Division. Filed Expert Report on September 23, 2016. Case involved analyzing damages resulting from claims of trade secret misappropriation, breach of contract, and tortious interference in the market for nutraceuticals. Filed supplemental report on October 24, 2016, and a supplemental report on June 16, 2017. Provided deposition testimony on December 5, 2016.

David Weiner, et al. v. Ocwen Financial Corporation, et al.
Case No. 2:14-cv-02597-MCE-DB, US District Court for the Eastern District of California. Filed Expert Report regarding class certification on January 30, 2017 in a class action case that involved analyzing loan level data to determine fees paid by borrowers related to certain mortgage-related valuation services. Filed Rebuttal Expert Reports on April 5, 2017 and May 6, 2019. Filed a Damages Report on March 6, 2019. Provided deposition testimony on February 21, 2017 and on April 5, 2019.

Dina Andren et al. v. Alere, Inc., et al.
Case No. 3:16-cv-01255-GPC-NLS, US District Court for the Southern District of California. Filed Expert Report on June 21, 2017. Case involved class action damages related to claims of deceptive and misleading trade practices in the medical device industry.

Sphero Inc. v. Spin Master, LTD., et al.
Case No: 17-cv-5428, US District Court for the Southern District of New York. Filed Expert Declaration on July 18, 2017 pertaining to irreparable harm and balance of equities related to a preliminary injunction motion. Case involved claims of deceptive patent infringement in the consumer electronics market. Provided deposition testimony on August 17, 2017 and hearing testimony on August 23, 2017.

United States of America v. Jesse Roberts, III
Criminal No: 15-20-JWD-EWD, US District Court for the Middle District of Louisiana. Testified at trial on August 8, 2017. Testimony pertained to analyses of securities trading records in an insider trading case.

Barbara Waldrup, et al v. Countrywide Financial Corporation, et al.
Case No.: 2:13-cv-08833-CAS(AGRx) consolidated with Case No.: 2:16-cv-4166 CAS(AGRx), US District Court for the Central District of California. Filed Expert report on August 28, 2017 and testified at deposition on September 22, 2017. Testimony pertained to class-wide damages resulting from claimed illegitimate appraisals for home mortgages.

Custopharm, Inc. v. Chemworth, Inc., et al.
Case No.: AU:15-CV-00841-RP, US District Court for the Western District of Texas, Austin Division. Filed Expert report on October 17, 2017. Case involved breach of contract claims between two drug development companies. Supplemental report filed on January 10, 2018. Testified at trial on April 18, 2018.

Twin Rivers Engineering, Inc. v. Fieldpiece Instruments, Inc., et al.
Case No.: 2:16-cv-04502-MLH-MRW, US District Court for the Central District of California. Filed Expert report on December 27, 2017. Case involved liability and damages assessments related to antitrust, Lanham Act, and patent infringement claims in the hand-held leak detector industry. Testified at trial on May 31, 2018.

RSL Holding, LLC et al. v. Gregory Smith, et al. AND Iberiabank v. US Rail Services, LLC, et al.
Cause No.: 2016-46164, 164th Judicial District of Harris County, Texas; and Cause No.: 2016-58070, 129th Judicial District of Harris County, Texas. Filed Expert Affidavit on February 5, 2018. Case involved valuation and damages assessments related to breach of contract and fraud claims in post-acquisition dispute.

Total Rod Concepts, Inc. v. Glasforms, Inc., et al.
Cause No.: 14-05-05365, in the District Court for the 410th Judicial District, Montgomery County, Texas. Filed Expert report on February 21, 2018, and provided deposition testimony on March 23, 2018. Case involved damages assessments related to breach of contract and misappropriation of trade secrets claims in the fiberglass sucker rod industry.

S&A Capital Partners, Inc. et al. v. JP Morgan Chase Bank, N.A., et al.
Case No.: 1:15-cv-00293-LTS-JCF, US District Court in the Southern District of New York. Filed Expert report on July 9, 2018 and sur-rebuttal report on December 17, 2018. Case involved damages assessments related to breach of contract and fraud in the market for distressed residential mortgages. Testified at deposition on January 31, 2019.

Greg Friedlander, et al. v. John V. “Jack” McGary
Cause No.: D-1-GN-16-005169, in the District Court for the 261th Judicial District, Travis County, Texas. Filed Expert report on August 1, 2018. Case involved damages

assessments related to breach of fiduciary duty and fraud in the market for the booking of celebrity speakers. Testified at trial on January 17, 2019.

Likarish Enterprises, Inc. v. SkiHi Enterprises, Ltd.
Cause No.: CV-16-0910, in the District Court for the 397th Judicial District, Grayson County, Texas. Filed Expert report on August 7, 2018. Case involved damages assessments related to breach of contract, negligence, and breach of duty to perform in the alcoholic spirits market.

CVS Heath Corporation, et al. v. Vividus, LLC., et al.
AAA Case No. 01-14-0002-0801, American Arbitration Association. Filed Expert report on September 21, 2018. Case involved quantifying antitrust and commercial damages related to claims of collusion and breach of contract in the market for compounding pharmacies.

Sally Ann Reagan v. Ganesh Ramachandran Iyer and Morgan Stanley
FINRA Case No. 17-01985. Filed Expert report on October 10, 2018 and testified at the arbitration hearing on November 1, 2018. Case involved analyzing the riskiness of investments and assessing damages in an arbitration claiming an investor’s funds were invested in unsuitable investments.

HEB Grocery Company, LP v. Todd Meagher, et al.
Civil Action No. 4:17-cv-02810, in the United States District Court of the Southern District of Texas, Houston Division. Issued Federal Rule 26 Report, dated November 2, 2018 and testified at deposition on December 19, 2018. Case involved valuing a start-up business and assessing damages associated with the Defendants’ counterclaim of trademark bullying.

ExxonMobil, et al. v. Deutsche Telekom, et al.
2014 WIPO Arbitration Rules, CASE NO. WIPOA130218. Issued expert report on February 21, 2019 and a rebuttal report on April 11, 2019 in an International arbitration in London. The report addressed “negotiating damages” resulting from the alleged breach of a settlement agreement related to a prior trademark dispute.

Acceleron, LLC v. Dell, Inc.
Case Number 1:12-cv-04123, US District Court, Northern District of Georgia, Atlanta Division. Issued expert report on May 24, 2019 in a patent infringement dispute involving blade server technology. The report addressed reasonable royalty damages, as well as a critique of the Plaintiff’s expert report. Testified at deposition on June 21, 2019. Testified at trial on September 16-17, 2021.

Christopher M. Beuchler, et al. v. James W. Thompson, et al.
Cause Number D-1-GN-17-005884, District Court of Travis County, Texas, 459th Judicial District. Issued preliminary expert report on July 11, 2019 in a business dispute involving open source firewall and router software. The report addressed damages related to claims of fraud, breach of fiduciary duty, and breach of contract, among others.

Vitol Americas Corp. v. Targa Channelview, LLC.
Cause Number 2018-90859, District Court of Harris County, Texas, 80th Judicial District. Filed an initial expert report on December 12, 2019 in a business dispute involving a splitter facility in Channelview, TX. Report quantified benefit of the bargain and restitutionary damages. Provided deposition testimony on January 31, 2020 and on May 12, 2020. Provided trial testimony on September 29, 2020.

Emily Sears, et al. v. Russell Road Food and Beverage, et al.
Case Number 2019-cv-01091, United States District Court for the District of Nevada. Filed an initial expert report on March 2, 2020 in a Lanham Act dispute involving alleged misappropriation and unauthorized publication of the image and likeness of models. Report addressed the likelihood of confusion and economic damages.

Twinwood Cattle Company, Inc. v. American Akaushi Association, et al.
Civil Action Number 18-DCV-250789, in the District Court of Fort Bend County, Texas, 458th Judicial District. Filed an initial expert report on May 7, 2020 in a breach of contract and fraud dispute involving specialized Japanese cattle. Report addressed economic damages. Supplemental report filed September, 18, 2020 and additional rebuttal report filed on March 16, 2021. Testified in deposition on July 8th, 2020 and April 23, 2021. Testified at court hearing on January 29, 2021 and at trial on July 15, 2021.

Jaymo's Sauces, LLC. v. The Wendy's Company
Case No.: 19-cv-1026, in the United States District Court for the Central District of Illinois. Filed an expert rebuttal report on October 23, 2020 in a trademark infringement case involving food products. Report addressed economic damages and unjust enrichment. Filed an affirmative expert damages report on January 29, 2021.

BNSF Railway Company, et al. v. Dynegy Midwest Generation, LLC.
AAA Case No.: 01-18-0001-3283, American Arbitration Association case. Filed an expert report on January 18, 2021 in a breach of contract case involving coal transportation to a power generation facility. Report addressed the issue of the appropriate discount rate for economic damages.

David Yoder and Yoder Naturals, LLC v. YGHR Sales, LLC et al.
Case No.: 8:18-cv-01983 DCC, in the United States District Court for the District of South Carolina, Anderson Division. Filed an expert report on January 22, 2021 in a trademark infringement case involving nutraceuticals. Report addressed the issue of likelihood of confusion. Testified at deposition on March 11, 2021.

In Re: WC South Congress Square, LLC Bankruptcy
Case No. 20-11107-tmd, in the United States Bankruptcy Court for the Western District of Texas, Austin Division. Issued expert report on April 9, 2021 related to the appropriate cram-down interest rate for the debtor's proposed plan of reorganization. Testified at the bankruptcy proceeding on April 15, 2021.

Mid-Atlantic Finance Co., Inc., v. Prime Asset LLC, et al.
Cause No. D-1-GN-19-000954, in the District Court of Travis County, Texas, 250th Judicial District. Case is related to a misappropriation of trade secrets claim in the subprime auto loan industry. Testified at hearing on April 12, 2021, issued expert report on October 5, 2022 and rebuttal expert report on November 21, 2022.

In Re: Residential Capital LLC, et al Bankruptcy
Case Number 12-12020-mg, in the United States Bankruptcy Court for the Southern District of New York. Issued expert report on August 6, 2021 related to a breach of contract claim in the mortgage lending industry. Testified in deposition on October 28, 2021

Daniel Fishbaugh v. Art Bulgadarian et al.
Case No.: 2:20-dv-01135-JWH-RAO in the United States District Court Central District of California Western Division. Issued expert report on September 17, 2021 related to damages incurred by the plaintiff related to numerous causes of action, including copyright infringement, promissory fraud, unfair competition, and breach of contract.

Surveying and Mapping, LLC v. Dustin E. Trousil, et al.
Cause No.: D-1-GN-20-001527 in the United States District Court of Travis County, Texas, 261st Judicial District. Issued preliminary expert report on November 5, 2021. My report addressed damages incurred by the plaintiff related to numerous causes of action, including breach of contract, tortious interference, and misappropriation of trade secrets. Issued an affidavit in the matter on December 12, 2022.

Mary Evans, et al. v. Enterprise Products Partners, LP, et al.
Cause No.: 2019-57694 in the District Court of Harris County Texas, 165th Judicial District. Issued expert report on November 19, 2021. The report addressed issues of class certification related to dispute involving pipelines installed in residential neighborhoods. Provided deposition testimony on February 16, 2022.

Phage Diagnostics, Inc. v. Corvium, Inc.
C.A. No. N19C-07-200-MMJ[CCLD] in the Superior Court in the State of Delaware. Issued expert declaration on December 29, 2021 in a post-acquisition dispute involving technologies that detect food-borne bacteria, such as listeria and salmonella. Expert Reports issues on May 20, 2022 and June 22, 2022. Deposition testimony provided on July 14, 2022 and trial testimony provided on October 25, 2022.

Leon A. Malca v. Rappi, Inc.; Sebastian Mejia
C.A. No. 2020-0152-MTZ in the Court of Chancery in the State of Delaware. Issued expert report on March 18, 2022 in a shareholder dispute. The report addressed the valuation of a minority interest of a privately held company in the food delivery industry. I issued a response report on April 1, 2022.

National Polypropeline Consultants v. Panatecvh Devices, S.A.
Arbitration. No. 215208 in the London Court of International Arbitration.

Issued expert report on June 17, 2022 in a fraud and breach of contract case involving drag reducing agents for oil and gas transmission. The report addressed benefit-of-the-bargain damages. I provided deposition testimony on July 27, 2022 and testified at arbitration on August 25, 2022.

Textron Innovations, Inc. v. SZ DJI Technology Co., LTD., et al.
Case No. RG19001604 in the United States District Court for the Western District of Texas, Waco Division. Issues expert report on December 8, 2022 regarding patent damages in a case involving drone technology and a supplemental report on January 19, 2023. Provided deposition testimony on January 24, 2023 and trial testimony on April 18, 2023.

Joshua Chodniewicz, et al. v. Art.com, Inc., et al.
Civil Action No. 6:21-cv-740 in the Superior Court of the State of California, County of Alameda. Issues expert report on February 1, 2023 regarding issues related to WALMART's acquisition of Art.com, including valuations and other financial analyses. Provided deposition testimony on March 24, 2023.

Blue Bottle Coffee, LLC v. Hui Chuan Liao, et al.
Case No. 3:21-cv-06083-CRB in the United States District Court for the Northern District of California. Issued expert report on May 22, 2023 that addressed brands and branding. Provided deposition testimony on July 26, 2023.

Pecos River Exploration Holdings, LLC et al. v. MBL Pecos River Exploration, LLC, et al.
AAA Case No. 01-23-0000-4266. Issued damages report on June 19, 2023 involving the valuation of E&P assets in the Permian Basin. Testified at arbitration on July 14, 2023.

Milton 635 Gravois Road, LLC, et al. v. TRT Holdings, Inc., et al.
Cause number DC-21-11406 in the District Court 44th Judicial District, Dallas County, TX. Issued report on September 25, 2023 involving damages related to alleged fraud in the real estate industry.

Cloud49, LLC v. Rackspace Technology, Inc., et al.
Civil Action number 1:22-cv-229 in the United States District Court for the Western District of Texas, Austin Division. Issued report on September 25, 2023 involving damages related to bid-rigging in the cloud technology services industry.

Sectra Communications AB, et al. v. Absolute Software, Inc. et al.
Case number 2:22-cv-00353-RSM in the United States District Court for the Western District of Washington, Seattle Division. Issued report on December 21, 2023 involving patent damages in a case about mobile VPN technology. Issues rebuttal report on April 12, 2024.

Advanced Micro Devices, Inc. v. Polaris Innovations, LTD.
Civil Action Number 1:23-cv-00304-DAE in the United States District Court for the Western District of Texas, Waco Division. Issued damages report in a breach of contract

and tortious interference case involving contractual licensing relationship between a semiconductor manufacturer and a patent holding company. Report issued on January 15, 2024.

The State of Texas v. Google, Inc.
Cause Number 22-01-88230 in the District Court of Victoria County Texas, 377th Judicial District. Issued expert report on January 16, 2024 addressing Deceptive Trade Practices Act (DTPA) penalties related to alleged violations regarding Google's Location and Incognito mode settings. Issued a supplemental disclosure and provided deposition testimony on May 24, 2024.

Fractus, S.A. v. ADT, LLC d/b/a ADT Security Services
Civil Action Number 2:22-cv-412 in the United States District Court for the Eastern District of Texas, Marshall Division. Issued expert report on March 25, 2024 addressing patent infringement damages related to antennae technology. Provided deposition testimony on April 3, 2024

LifeScan, Inc. v. Jeffrey C. Smith, et al.
Civil Action Number 2:17-cv-5552-CCC-JSA in the United States District Court for the District of New Jersey. Issued Expert report on April 15, 2024 addressing damages related to an alleged fraudulent scheme to take advantage of separate insurance regimes for blood glucose test strip products.

Roche Diagnostic Corp. et al v. Jeffrey C. Smith, et al.
Civil Action Number 2:19-cv-08761-CCC-JSA in the United States District Court for the District of New Jersey. Issued Expert report on April 15, 2024 addressing damages related to an alleged fraudulent scheme to take advantage of separate insurance regimes for blood glucose test strip products.

REPRESENTATIVE CASES

ANTITRUST MATTERS

Performed liability analysis related to an electricity market manipulation claim.

Analyzed liability and assessed damages in a restraint of trade case in the market for HVAC leak detectors. The case also involves claims of patent infringement and Lanham Act violations.

Performed economic damages analyses for a generic pharmaceutical company that was allegedly kept from entering a specific antibiotic market by the branded company through fraudulently obtained patent protection.

Analyzed liability and assessed damages associated with an alleged Resale Price Maintenance Agreement in the "cosmeceutical" industry.

Calculated antitrust damages related to price discrimination and fraud claims in the wholesale home furniture industry.

Examined economic issues related to alleged tying arrangements practiced by a medical device company.

Performed economic analysis related to a Section I and II claim in the laboratory airflow control systems market.

Examined a tying and bundling claim in the television broadcasting industry. Determined economic damages suffered by purchasers of ammonium nitrate due to price fixing.

Performed liability and economic damages analyses, as well as litigation support for an international client accused of collusion in the vitamins industry.

Performed liability and economic damages analyses and litigation support for an international client accused of collusion in the amino acids industry.

CORPORATE RECOVERY

Determined “cram-down” interest rate for bankruptcy proceeding involving commercial real estate company.

Valued a hotel property in Hawaii that was involved in a bankruptcy proceeding.

Performed a fraudulent transfer and preference analysis of the pre-petition transactions to determine avoidability, valued corporate assets, assessed litigation alternatives for additional recoveries, and reviewed debtors’ proposed business plan.

Conducted individual practice assessments, market surveys, and damage estimates associated with the failure of a physicians practice management company.

Performed financial analyses related to the pre-petition financing and collateral position of a Chapter 11 telecommunications company.

Analyzed investor claims of legal malpractice to assess recovery possibilities. Also, performed various financial analyses to determine the feasibility of class certification.

INTELLECTUAL PROPERTY

Engaged to quantify economic damages in a patent infringement case involving power converters for computer equipment.

Retained to quantify damages in a patent infringement matter involving drone technology.

Retained to quantify economic damages in a misappropriation of trade secrets case in the sub-prime auto loan industry.

Engaged to address Lanham Act damages in a Lanham Act dispute involving consumer products companies that manufacture and distribute air freshener products.

Engaged to address likelihood of confusion and damages in a trademark infringement dispute involving remote controlled vehicles.

Engaged to quantify damages in a Lanham act case involving false and misleading advertising claims in the timeshare industry.

Engaged to quantify damages to a hospital system resulting from fraud and negligent marketing claims against opioid manufacturers and distributors.

Assessed liability and quantified damages in a misappropriation of trade secrets dispute between two drilling fluids services firms.

Retained by defense counsel to opine on patent infringement damages in a matter involving technology for blade servers.

Engaged by defense counsel to opine on liability and damages in a trademark and trade dress litigation between two companies that manufacture beverage tumblers.

Quantified damages and opined on certain liability issues in a false advertising case involving two medical device companies who manufacture products for laparoscopic surgery.

Engaged to quantify damages and opine on liability issues in a trademark infringement matter involving the health benefits management industry.

Analyzed and rebutted confusion and dilution surveys performed by defense experts in a trademark dispute between a large oil company and a world-renowned entertainment company.

Engaged by plaintiff's counsel to quantify patent infringement damages in the computer software industry.

Evaluated the Plaintiff's damages claim and offered affirmative damages opinions in a breach of contract case involving the licensing of patented technology in the cosmeceutical industry.

Engaged by counsel for the defense to evaluate trademark infringement damages in a dispute between an international restaurant chain and a regional convenience store chain.

Engaged by counsel for the defense to evaluate liability and damages in a trademark infringement suit involving an online nostalgia company.

Quantified trademark infringement and false advertising damages in a dispute between two food products companies.

Determine patent infringement damages in a matter involving computer hardware technology.

Calculated damages in a misappropriation of trade secrets case between two computer software firms.

Provided business strategy and licensing assistance to the owner of an Internet patent portfolio.

Determined damages in a patent infringement case involving two "nutraceuticals" companies.

Assessed reasonable royalty and lost profits claim involving baseball training product.

Assessed lost profits and diminution of business value claims involving a misappropriation of trade secrets dispute between a start-up biotechnology firm and a nationally renowned research institution.

Assessed the amount of reasonable royalties due to patent infringement involving two air-jet weaving machine patents. Critiqued lost profits and reasonable royalties claimed by plaintiff.

Determined the amount of reasonable royalties due to patent infringement in the prepaid wireless telecommunications industry.

Engaged by plaintiff to assess lost profits damages for a company in the cardiac rhythm management business. Developed lost profits damages model, critiqued lost profits claimed by defendant, assisted in preparing for expert deposition and trial, and prepared prejudgment interest model and affidavit.

Assessed the amount of reasonable royalties due to patent infringement involving a patent for pet snacks.

VALUATION AND DAMAGES

Retained to quantify damages in an unfair competition case involving a multinational technology conglomerate.

Quantify damages in a breach of contract case involving drag-reducing agents for the oil and gas industry.

Determined damages in a breach of contract case between healthcare technology company and an insurance syndicate.

Engaged by counsel for the defense to value an oil and gas exploration and production company.

Valued natural gas salt-domed storage facility.

Valued natural gas pipeline facility.

Quantified damages in an arbitration dispute involving two joint venture partners in a natural gas trading and marketing business.

Provided cost of services testimony in a PUC rate case.

Engaged by plaintiff's counsel to opine on economic damages in a case involving the resale of underperforming residential mortgages.

Prepared intellectual property valuation for a company in the neuro-marketing field. The valuation report was used for acquisition purposes.

Engaged by defense counsel to provide class certification and damages opinions in a class action case involving ground water contamination.

Quantified class-wide damages for a case involving credit card interchange fees.

Performed valuation of a biotechnology company engaged in a breach of contract dispute involving preclinical and Phase I pharmaceuticals.

Assessed damages associated with breach of a natural gas processing and purchase contract. Determined well connection costs, well deliverability, well capacity, and compression maximums. Also, analyzed gains to producers from gaming nominations to pipelines.

Calculated the termination payment for a portfolio of interest rate swaps determined based on the Loss method as defined in the 1992 International Swaps and Derivatives Association Master Agreement.

Performed class certification analyses for defendant in a large class action lawsuit involving an oil spill in the Gulf Coast region. Work involved analysis of medical class, the Seafood Compensation Program, Property Damages Class,
and other Economic Damages Classes.

Analyzed issues pertaining to a large family enterprise involved in an estate tax examination.

Valued a herd of full-blood, Japanese cattle as part of a damages analysis in a fraud and breach of contract case.

Assessed damages in a breach of contract case involving life settlement policies.

Calculated damages resulting from the withholding of restricted securities in association with an acquisition of a Phase I/Phase II biotechnology firm.

Valued investment advisory business involved in an administrative proceeding with the Securities and Exchange Commission.

Performed damages and liability analyses on a litigation matter involving terminations of interest rate swaps.

Performed a variety of complex analyses on a securities matter involving a large mortgage origination company. Our work entailed quantifying gains from insider trading, as well as analyzing various liability issues.

Provided analysis regarding the appropriate discount rate to employ in a damages calculation involving a failed pipe casing.

Assessed damaged and valued minority interest of a spirits manufacturer related to a post-acquisition dispute.

Provided economic and financial analysis to a large bank involved in a dispute regarding the bank’s involvement in a loan syndicate. The dispute was related to the cable television industry.

Calculated personal injury damages due to a small business owner resulting from an automobile accident.

Performed econometric and financial analyses for the defendants in a large, securities class action case involving initial public offerings.

Calculated damages in a large 10B-5 litigation involving a document management technology and service company.

Assessed the real property value of a Hawaiian hotel involved in a bankruptcy related dispute.

Engaged to provide damages analysis in a 10B-5 litigation involving a defunct broadband company.

Performed valuation of derivative financial instruments in an Enron-related criminal matter.

Quantified damages for defense counsel in a large securities class action case involving a bankrupt energy company.

Calculated damages in a dispute involving nitrogen production units (NPU's) in the oil field services industry.

Performed damages analysis in a 10B-5 litigation involving a medical device firm.

Engaged by counsel for the defense to provide liability and damages opinions relative to a securities litigation involving derivative financial instruments.

Assessed mutual fund trading activities of alleged market timers and late traders for the SEC.

Performed analyses for the state of Texas to assist in analyzing proposed legislation regarding investment disclosure requirements.

Assessed damages due to a large airplane engine manufacturer resulting from faulty equipment produced by a sub-contractor.

Performed a business valuation of a hydroxides manufacturing unit for a multinational client in a breach of contract case.

Conducted damages analysis related to a post-merger dispute between a large express mail company and two of its European affiliates.

Conducted damage analyses related to alleged 10B5 securities violations by a large waste industry company.

Assessed stock and future earn out damages associated with claims of fraud and misrepresentations related to an acquisition of consumer car care products.

Assessed damages claim in a breach of contract case involving two parking services companies.

OTHER MATTERS

Engaged by major international company to perform econometric analyses on the Global Crude Oil Market.

Engaged by mortgage servicing company to determine its ability to pay fines levied against it by the Consumer Financial Protection Bureau (CFPB). The case related to illegal foreclosure practices.

Retained by the SEC in an administrative matter against the executives of a major mortgage servicing company. The engagement entailed evaluating loans for compliance with reps and warranties, as well as determining the gains made by the executives resulting from incorrect disclosures.

Performed analysis regarding the quality of due diligence conducted in a transaction involving a major international restaurant company. The plaintiff, a joint venture partner responsible for West Coast franchise expansion, sued the restaurant chain and its acquirers for breach of contract and fraud.

Performed analyses regarding corporate governance issues for a large accounting firm involved in a litigation case that alleged accounting malpractice.

Retained by a trustee for a mortgage-backed securities structured trust to determine whether mortgage loans in a trust complied with the representations and warranties made about the loans in loan purchase agreements.

Assisted a large national insurance carrier in the divestiture of its healthcare practice.

Performed Y2K readiness assessments on behalf of state insurance regulatory boards.

Managed an engagement to eliminate a large claims backlog for an insolvent insurance carrier.

Retained by trustee to examine a mortgage origination company's policies and practices in the areas of mortgage loan underwriting and mortgage loan sales, as well as its policies and practices related to quality control and quality assurance in these areas.

Helped the City of Pittsburgh value its parking assets and evaluate various alternatives for monetizing them to fund the city's pension shortfall.

Retained by GSE (Government Sponsored Entity) to evaluate its risk management policies and procedures related to its mortgage purchasing activities. In the case, the GSE sued a Big 4 accounting firm for failing to detect fraud at a now defunct mortgage bank during its audits.

Retained by Plaintiff counsel to evaluate class-certification issues in multiple mortgage-backed securities cases.

Materials Relied Upon

Legal Filings
Fourth Amended Complaint in State of Texas et al. vs. Google LLC, In Re: Google Digital Advertising Antitrust Litigation, Civil Action No. 1:21-cv-06841-PKC, May 5, 2023
Defendant Google LLC's Responses and Objections to Plaintiffs' Second Set of Interrogatories, April 8, 2024
Defendant Google LLC's First Amended Responses and Objections to Plaintiffs' Third Set of Interrogatories, May 24, 2024
[redacted]

Case Law
Brown et al. v. Google LLC, Plaintiffs' Unopposed Motion for Final Approval of Class Action Settlement (April 1, 2024)
Halo Electronics, Inc. v. Pulse Electronics, Inc. 579 U.S. (2016)
Office Of The Att'y Gen., State Of Florida, Dep't Of Legal Affairs v. All USA Van Lines Inc., No. CACE18029679 (Fla. 17th Cir. Ct. May 20, 2022)
Rohrer v. Knudson, 203 P.3d 759 (Mont. 2009)
Spradling v. Williams, 566 S.W.2d 561 (Tex. 1978)
State ex rel. Nixon v. Consumer Auto. Res., Inc., 882 S.W.2d 717, 722 (Mo. Ct. App. 1994)
State ex rel. Wilson v. Ortho-McNeil-Janssen Pharm., Inc., 777 S.E.2d 176, 203 (S.C. 2015)
United States v. Phelps Dodge Indus., Inc., 589 F. Supp. 1340, 1362 (S.D.N.Y. 1984)

Depositions
Deposition of [redacted], March 31, 2021
Deposition of [redacted], August 15, 2023

Declarations
Declaration of [redacted], August 4, 2023
Declaration of [redacted], August 5, 2023
Declaration of [redacted], May 24, 2024

State Laws
Alaska Unfair Trade Practices and Consumer Protection Act, available at https://www.akleg.gov/basis/statutes.asp#45.50.561
Arkansas Code § 4-88-107, available at https://law.justia.com/codes/arkansas/2020/title-4/subtitle-7/chapter-88/subchapter-1/section-4-88-107/
Arkansas Code § 4-88-113, available at https://law.justia.com/codes/arkansas/2020/title-4/subtitle-7/chapter-88/subchapter-1/section-4-88-113/
Florida Statutes 2023, available at http://www.leg.state.fl.us/statutes/index.cfm?App_mode=Display_Statute&Search_String=&URL=0500-
Idaho Consumer Protection Act, available at https://legislature.idaho.gov/statutesrules/idstat/title48/t48ch6/
Idaho Rules of Consumer Protection, available at https://adminrules.idaho.gov/rules/current/04/040201.pdf
Indiana Deceptive Consumer Sales Act, available at https://law.justia.com/codes/indiana/2022/title-24/article-5/chapter-0-5/section-24-5-0-5-3/
Kentucky Revised Statutes, available at https://apps.legislature.ky.gov/law/statutes/statute.aspx?id=34914
Louisiana Unfair Trade Practices and Consumer Protection Law, available at https://legis.la.gov/Legis/Law.aspx?d=104031
Mississippi Consumer Protection Act, available at https://law.justia.com/codes/mississippi/2020/title-75/chapter-24/subchapter-
Missouri Statute 407.020, available at https://revisor.mo.gov/main/OneSection.aspx?section=407.020&bid=48371
Missouri Statute 407.100, available at https://revisor.mo.gov/main/OneSection.aspx?section=407.100&bid=23016
Montana Code Annotated, available at https://leg.mt.gov/bills/mca/title_0300/chapter_0140/part_0010/section_0020/0300-0140-0010-0020.html
Nevada Revised Statutes 598.0915-598.0925, available at https://www.leg.state.nv.us/nrs/NRS-598.html#NRS598Sec0999
Nevada Revised Statutes 598.0999, available at https://www.leg.state.nv.us/nrs/NRS-598.html#NRS598Sec0999
North Dakota Century Code, available at https://ndlegis.gov/cencode/t51c15.pdf#nameddest=51-15-11
Puerto Rico Laws 10 L.P.R.A. , available at https://casetext.com/statute/laws-of-puerto-rico/title-ten-commerce/subtitle-1-regulation-of-business-generally/chapter-13-monopolies-and-restraint-of-trade/259-fair-competition
South Carolina Unfair Trade Practices Act, available at https://www.scstatehouse.gov/code/t39c005.php
South Dakota Codified Laws, available at https://sdlegislature.gov/Statutes/37-24
Texas Deceptive Trade Practices Act, available at https://statutes.capitol.texas.gov/Docs/BC/htm/BC.17.htm
15 U.S. Code § 15
18 U.S. Code § 1964
35 U.S. Code § 284
Utah Consumer Sales Practices Act 13-11-17, available at https://le.utah.gov/xcode/Title13/Chapter11/C13-11_1800010118000101.pdf
Utah Consumer Sales Practices Act 13-11-4, available at https://le.utah.gov/xcode/Title13/Chapter11/C13-11_1800010118000101.pdf

Expert Reports
Expert Report of Dr. John Chandler, June 7, 2024
Expert Report of Dr. Joshua Gans, June 7, 2024
Expert Report of Dr. Matthew Weinberg, June 7, 2024

Academic Literature
Berk and DeMarzo, Corporate Finance, 3rd Edition
Boushie, Kristopher A., et al. Calculating and Proving Damages. Law Journal Press, 2011, §1.04[1] at 1-9, §9.10[1] at 9-40
Brealey, Richard A., Myers, Stewart C., and Allen, Franklin, Principles of Corporate Finance, McGraw-Hill/Irwin, Tenth Edition: 2011
Carolyn Carter, Consumer Protection in the States: A 50-State Evaluation of Unfair and Deceptive Trade Practices Laws, National Consumer Law Center, March 2018, available at https://www.nclc.org/wp-content/uploads/2022/09/UDAP_rpt.pdf, accessed 6/4/2024
Choi, Hana et al., "Online Display Advertising Markets: A Literature Review and Future Directions," Information Systems Research 31:2 (2020)

Evans, David S. and Richard Schmalensee, “The Antitrust Analysis of Multisided Platform Businesses” in Oxford Handbook of International Antitrust Economics, Volume 1 (2015)
Pratt, Reilly, Schweihs, Valuing a Business, McGraw-Hill Irwin, Third Edition: 1996
Ross, Westerfield, Bradford, Fundamental of Corporate Finance McGraw-Hill Irwin, 9th edition
Weil, Roman L. et al. Litigation Services Handbook The Role of the Financial Expert, John Wiley & Sons, Inc. 2012, Fifth Edition

Journals
J. Gregory Sidak, Rethinking Antitrust Damages, 33 STAN. L. REV. 329, 330 (1981), available at https://www.criterioneconomics.com/docs/rethinking_antitrust_damages1.pdf
Judith A. Morse, Treble Damages under RICO: Characterization and Computation, 61 Notre Dame L. Rev. 526 (1986)

Financials
Alphabet Inc. Form 10-Ks for fiscal years ending 2016 – 2023
Alphabet Inc., Q1 2024 Earnings Call, Apr 25, 2024
Google Inc., Form 10-Ks for fiscal years ended December 31, 2009 through December 31, 2015

Articles & Websites
"Digital ad spend worldwide to pass $600 billion this year", Emarketer (Jul 14, 2023), available at https://www.emarketer.com/content/digital-ad-spend-worldwide-pass-600-billion-this-year.
"How Open Bidding Works," Google Ad Manager, November 20, 2019, available at https://web.archive.org/web/20191120001210/https:/support.google.com/admanager/answer/7128958
“About Google,” available at https://about.google/intl/ALL_us/
“Ads and Data,” Google Safety Center, available at https://safety.google/privacy/ads-and-data/
Digital Advertising in the United States – statistics & facts, Statista (December 18, 2023), Digital ad spend worldwide to pass $600 billion this year, eMarketer (July 14, 2023), https://www.statista.com/topics/1176/online-advertising/#editorsPicks
“Display Advertising,” Jargon Buster IAB UK, available at https://www.iabuk.com/jargon-buster?op=Apply&title=display
DOJ’s Ad Tech Antitrust Case Against Google: A Brief Overview, Congressional Research Service Legal Sidebar (May 5, 2023), https://crsreports.congress.gov/product/pdf/LSB/LSB10956
“DSP, SSP, and Ad Exchange: What’s the Difference?,” Mountain, available at https://mountain.com/blog/dsp-ssp-ad-exchange/
First-Party Ad Server vs. Third-Party Ad Server, Playwire, available at https://www.playwire.com/blog/first-party-ad-server-vs-third-party-ad-server
Google Ad Center Help, available at https://support.google.com/My-Ad-Center-Help/answer/12156161
Google Ad Manager “Smarter optimizations to support a healthier programmatic market,” May 12, 2016, available at https://blog.google/products/admanager/smarter-optimizations-to-suppor/
“Google Acquires AdMeld For $400 Million,” TechCrunch, June 9, 2011, available at https://techcrunch.com/2011/06/09/google-acquires-admeld-for-400-million/
“Google Buys DoubleClick for $3.1 Billion,” New York Times, April 14, 2007, available at https://www.nytimes.com/2007/04/14/technology/14DoubleClick.html
“Google Creates Parent Company Called Alphabet in Restructuring,” Wall Street Journal, August 10, 2015
“Google Establishes Alphabet Holding Company,” Wall Street Journal, October 2, 2015, available at https://www.wsj.com/articles/google-to-establish-alphabet-holding-company-after-close-of-trading-friday-1443801447
“Google Expands Advertising Monetization Program for Websites,” Google Blog, June 18, 2003, available at
“Google to pay $155 million in settlements over location tracking,” Reuters, September 15, 2023, available at https://www.reuters.com/legal/google-pay-155-million-settlements-over-location-tracking-2023-09-15/
“Google turns 20: how an internet search engine reshaped the world,” The Verge, September 17, 2018, available at https://www.theverge.com/2018/9/5/17823490/google-20th-birthday-anniversary-history-milestones
“Google’s Final Price Tag for Invite Media: $81 Million,” All Things D, June 9, 2010, available at https://allthingsd.com/20100609/googles-final-price-tag-for-invite-media-81-million/
“Google’s Scott Spencer On DoubleClick Ad Exchange Auction And Data Management,” ad exchanger, February 9, 2010, available at https://www.adexchanger.com/ad-exchange-news/googles-scott-spencer-on-doubleclick-ad-exchange-auction-and-data-management/
“Header Bidding 101,” Forbes, March 2, 2022, available at https://www.forbes.com/sites/forbesbusinesscouncil/2022/03/02/header-bidding-101/?sh=1304d401a970
How Three Mergers Buttressed Google’s Ad Tech Monopoly, Per DOJ, Tech Policy Press (March 9, 2023), https://www.techpolicy.press/how-three-mergers-buttressed-googles-ad-tech-monopoly-per-doj/
“How our business works,” available at https://about.google/how-our-business-works/
“How We Make Money with Advertising, Google, available at https://howwemakemoney.withgoogle.com/
Internet Advertising Revenue Report, Full-year 2023 Results, PwC (April 2024), https://s3.amazonaws.com/media.mediapost.com/uploads/IAB_PWC_Internet_Ad_Revenue_2024.pdf
“Introducing Google Ad Manager,” Google Blog, June 27, 2018, available at https://blog.google/products/admanager/introducing-google-ad-manage
“Introducing the Google Display Network,” Google Blog, June 18, 2010, available at https://adwords.googleblog.com/2010/06/introducing-google-display-network.html
“Our Story,” available at https://about.google/intl/ALL_us/our-story/
“Programmatic Advertising 101: What is a DSP?,” Basis Technologies, available at https://basis.com/blog/programmatic-101-dsps-explained
“Protections Overview, Google Ad Manger Help, available at https://support.google.com/admanager/answer/2913553
“Rolling out first price auctions to Google Ad Manager partners,” Google Ad Manager, September 5, 2019 available at https://blog.google/products/admanager/rolling-out-first-price-auctions-google-ad-manager-partners
“Search Engine Market Share Worldwide Jan – Dec 2023,” StatCounter, available at https://gs.statcounter.com/search-engine-market-share/all/worldwide/2023
“Second-Price Auction,” Smartclip, available at https://smartclip.tv/adtech-glossary/second-price-auction/

“Simplifying programmatic: first price auctions for Google Ad Manager,” Google Blog, March 6, 2019, available at https://blog.google/products/admanager/simplifying-programmatic-first-price-auctions-google-ad-manager/
“Site Targeting,” Google Blog, April 25, 2005, available at https://googlepress.blogspot.com/2005/04/site-targeting_25.html
“Site targeting: a refresher,” Google Blog, December 30. 2005, available at https://adsense.googleblog.com/2005/12/site-targeting-refresher.html
“Thank you for 25 years of curiosity,” available at https://blog.google/inside-google/company-announcements/google-25th-birthday/
The AdTech Book (Clearcode Services S.A., 2023), Ad Tech Explained (August 22, 2021), https://adtechexplained.com
“The Best Ad Exchanges for Publishers,” Publisher Growth, available at https://publishergrowth.com/category/platform/ad-exchanges
“The Best Advertising Technology (AdTech) Tools For Ecommerce,” Ecommerce Tech, available at https://ecommercetech.io/categories/advertising-technology
“The DoubleClick Ad Exchange: growing the display advertising pie for everyone,” Google Blog, September 17, 2009, available at https://googleblog.blogspot.com/2009/09/doubleclick-ad-exchange-growing-display.html
The History of Google Ads 20 Years in the Making, https://instapage.com/blog/google-adwords-infographic/.
“The Ultimate Guide to AdTech,” Hightouch, available at https://hightouch.com/blog/adtech
Top 50 Multi-Platform Properties (Desktop, Mobile, and Social), Comscore Media Metrix Multi-Platform, available at https://www.comscore.com/Insights/Rankings?country=US
“Types of Digital Advertising,” IDG Advertising, available at https://idgadvertising.com/types-of-digital-advertising/
“What Are First-Party Ad Servers (Publisher Ad Servers)?, available at https://www.mobileads.com/blog/ad-server/first-party-ad-server
“What is a Bid Request and How Does it Work?,” Set Up Ad, available at https://setupad.com/blog/bid-request/
“What is a Supply-Side Platform (SSP)? Here’s everything you need to know,” Amazon Ads, available at https://advertising.amazon.com/library/guides/supply-side-platform
“What is an Ad Server and How Does It Work,” Playwire, available at https://www.playwire.com/blog/what-is-an-ad-server-and-how-does-it-work
What is AdTech? Basics of The Ad Tech Ecosystem Explained, AdButler Blog (May 5, 2021), https://www.adbutler.com/blog/article/what-is-ad-tech-the-ad-tech-ecosystem-explained
What is digital advertising? A beginner’s guide, Amazon, https://advertising.amazon.com/library/guides/what-is-digital-advertising
“What is Programmatic Advertising? A Complete Guide for Agencies,” Agency Analytics, available at https://agencyanalytics.com/blog/what-is-programmatic-advertising
“Why We Ask Questions About Computer and Internet Use,” U.S. Census Bureau, available at https://www.census.gov/acs/www/about/why-we-
Why Google Switched to First Price Auction? Insider’s Insight, AdPushup (June 25, 2023), https://www.adpushup.com/blog/first-price-auction/#:~:text=6%20Mins%20Read,industry%20norm%20in%20programmatic%20advertising.

Public Materials
“Pandemic Impact on 2020 American Community Survey 1-Year Data,” United States Census Bureau, October 27, 2021, available at https://www.census.gov/newsroom/blogs/random-samplings/2021/10/pandemic-impact-on-2020-acs-1-year-data.html, accessed 1/10/2024
American Community Use Survey Information Guide, U.S. Census Bureau, October 2017, available at https://www.census.gov/content/dam/Census/programs-surveys/acs/about/ACS_Information_Guide.pdf, accessed 11/13/2023
S&P Capital IQ
U.S. Census Bureau Population Estimates and American Community Survey (ACS).

Other
Evans, David, “Two-Sided Platforms and Analysis of Single Firm Conduct,” DOJ Single Firm Conduct Hearings, September 2006, available at https://www.justice.gov/archives/atr/single-firm-conduct-hearings-comment-david-evans-two-sided-platforms-and-analysis-single-firm
Letter from David Pearl to Mark C. Mao and Walter Noss, Re: In re: Google Digital Advertising Antitrust Litigation, No. 1:21-md-03010 (PKC), May 30, 2023
Letter from David Pearl to Walter Noss, September 29, 2023, Appendix A
Letter from Freshfields Bruckhaus, Deringer US LLP dated May 24, 2024 “Re: State of Texas et al. v. Google LLC, No. 4:20-cv-957-SDJ (E.D. Tex.)

Bates Numbered Documents
[redacted]
GOOD-AT-MDL-00399609
GOOG-AT-MDL-000017381
GOOG-AT-MDL-001004706
GOOG-AT-MDL-001110980
GOOG-AT-MDL-001163787
GOOG-AT-MDL-001391101
GOOG-AT-MDL-002051716
GOOG-AT-MDL-002189396
GOOG-AT-MDL-003407129
GOOG-AT-MDL-004010113
GOOG-AT-MDL-004039971
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GOOG-AT-MDL-007393310
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GOOG-AT-MDL-014568201
GOOG-AT-MDL-015109224
GOOG-AT-MDL-017664768
GOOG-AT-MDL-019669370
GOOG-AT-MDL-B-001109245
GOOG-AT-MDL-DATA-000066537-482007
GOOG-AT-MDL-DATA-000508827-58886
GOOG-DOJ-03875910
GOOG-DOJ-06605325
GOOG-DOJ-13899276
GOOG-DOJ-13949282
GOOG-DOJ-14143524
GOOG-DOJ-14144983
GOOG-DOJ-14265301
GOOG-DOJ-14368357
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GOOG-DOJ-AT-01509153
GOOG-DOJ-AT-02634336
GOOG-DOJ-AT-02641400
GOOG-DOJ-AT-02647851_DUP_1
GOOG-DOJ-AT-02649870
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GOOG-NE-13202730
GOOG-NE-13204982
GOOG-NE-13229114

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GOOG-AT-MDL-B-002086688	GOOG-DOJ-AT-02224828	GOOG-TEX-00635680
GOOG-AT-MDL-B-004377628	GOOG-DOJ-AT-024 71194	GOOG-TEX-00777528
GOOG-AT-MDL-B-004435235	GOOG-DOJ-AT-02423615	[redacted]

All materials cited in this report and exhibits.
I have been provided access to the document database as well as all depositions related to this litigation.

Ratio of State Internet Population to U.S. Internet Population
2013 - 2023

State	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Alaska	0.22%	0.23%	0.25%	0.24%	0.23%	0.23%	0.23%	0.23%	0.22%	0.22%	0.22%
Arkansas	0.80%	0.79%	0.78%	0.81%	0.81%	0.83%	0.85%	0.82%	0.87%	0.87%	0.87%
Florida	5.69%	5.76%	6.37%	6.36%	6.42%	6.52%	6.58%	6.53%	6.60%	6.72%	6.72%
Idaho	0.52%	0.51%	0.52%	0.51%	0.52%	0.54%	0.56%	0.56%	0.58%	0.59%	0.59%
Indiana	2.03%	2.02%	1.98%	2.00%	2.00%	2.00%	1.99%	2.00%	2.03%	2.03%	2.03%
Kentucky	1.31%	1.29%	1.28%	1.31%	1.30%	1.31%	1.31%	1.30%	1.31%	1.32%	1.32%
Louisiana	1.30%	1.27%	1.31%	1.32%	1.30%	1.31%	1.32%	1.30%	1.32%	1.29%	1.29%
Mississippi	0.75%	0.76%	0.74%	0.80%	0.81%	0.82%	0.81%	0.79%	0.81%	0.82%	0.82%
Missouri	1.84%	1.82%	1.82%	1.84%	1.83%	1.83%	1.84%	1.81%	1.83%	1.82%	1.82%
Montana	0.31%	0.30%	0.32%	0.31%	0.32%	0.32%	0.32%	0.32%	0.33%	0.33%	0.33%
Nevada	0.87%	0.87%	0.92%	0.90%	0.91%	0.94%	0.93%	0.94%	0.95%	0.96%	0.96%
North Dakota	0.23%	0.23%	0.23%	0.23%	0.23%	0.22%	0.23%	0.23%	0.23%	0.23%	0.23%
Puerto Rico	0.67%	0.66%	0.73%	0.78%	0.76%	0.72%	0.78%	0.76%	0.84%	0.86%	0.86%
South Carolina	1.33%	1.33%	1.39%	1.45%	1.47%	1.49%	1.50%	1.48%	1.52%	1.55%	1.55%
South Dakota	0.27%	0.26%	0.26%	0.26%	0.26%	0.26%	0.27%	0.26%	0.26%	0.27%	0.27%
Texas	8.38%	8.40%	8.29%	8.52%	8.67%	8.70%	8.81%	8.80%	8.89%	9.04%	9.04%
Utah	1.02%	1.04%	1.01%	0.99%	1.00%	1.02%	1.03%	1.04%	1.04%	1.04%	1.04%
Total	**27.54%**	**27.55%**	**28.19%**	**28.63%**	**28.83%**	**29.07%**	**29.35%**	**29.18%**	**29.63%**	**29.96%**	**29.96%**

Notes: I apply 2022 ratios to 2023 as the U.S. Census Bureau has not yet released 2023 ACS data.
Sources: U.S. Census Bureau Population Estimates and American Community Survey (ACS).

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EXHIBIT 3

FILED UNDER SEAL

UNITED STATES DISTRICT COURT

EASTERN DISTRICT OF TEXAS

SHERMAN DIVISION

The State of Texas, et. al. Plaintiff, v. Google LLC, Defendant.	Case No: 4:20-cv-0095wei7

Expert Report of Jacob Hochstetler

6/7/2024

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Jacob Hochstetler

I. INTRODUCTION

A. Assignment

1. I understand that on December 16, 2020, a multistate coalition led by the State of Texas filed a lawsuit against Google LLC (Google) asserting violations by Google of federal and state antitrust laws and violations of other state laws, in connection with Google's conduct in the online display advertising industry and as to digital advertising technologies ("Ad Tech" or "Ad Tech stack"). Currently, 16 States (Texas, Alaska, Arkansas, Florida, Idaho, Indiana, Kentucky, Louisiana, Mississippi, Missouri, Montana, Nevada, North Dakota, South Carolina, South Dakota, and Utah) and the Territory of Puerto Rico are Plaintiffs in the case (Plaintiff States). I have been retained to provide expert analysis and opinions on behalf of all of the Plaintiff States.

2. I have been asked by counsel for the State of Texas, on behalf of all Plaintiff States in this case, to provide opinions regarding the operation of the products used in web display advertising. These products include ad servers, ad exchanges, and the tools used by publishers and advertisers. I have further been asked to provide opinions regarding the design and technical implementation of Google's Display Ads systems, including the DFP ad server, Google Ad Exchange, Google Ads, DV360, and their subsequent versions and variants, based on review of Google source code and production documents. I have also been asked to provide opinions regarding the technical implementation of the conducts within Google's suite of advertising products, including the technical implementation of Dynamic Allocation, Enhanced Dynamic Allocation, Exchange Bidding, Unified Pricing Rules, Bernanke, Dynamic Revenue Share, Reserve Price Optimization, all versions and variants thereof, and the technical integration of the DFP ad server and Google Ad Exchange.

3. I am competent to testify to the matters stated in this Report, have personal knowledge of the facts and statements herein, and each of the statements is true and correct.

4. In preparing this report, I have considered all of the documents referenced in this report as well as those listed in Appendices B and C. I have also relied on my own experience in the field of distributed systems, software engineering at scale, as well as API and infrastructure design. My opinion is based on the source code and documents available to me as of the time of this report. I reserve all rights to supplement my report should any additional information be produced in this case. I further reserve my right to use graphics, figures, and/or illustrations at trial to support my conclusions.

B. Qualifications

5. I am a Clinical Assistant Professor of Computer Science and Engineering at the University of North Texas. With 25 years of industry experience, I specialize in developing and managing software at scale, namely distributed networked systems. My expertise includes web technologies, C++, Golang, and Protocol Buffers. My major open-source work includes contributions to Envoy Proxy, a Cloud Native Computing Foundation project used by Google, and Telegraf, an agent for InfluxDB. My research interests include edge computing and distributed computing. As part of my employment at the University of North Texas, I have taught many courses in software design and engineering. I have also published papers on communications systems, edge computing, scalable datacenters, and the design of big data applications. My research has addressed multiple aspects of system interoperability, both in the context of mobile and non-mobile devices and in the use of machine learning in distributed computing systems.

6. I received my B.S. in Computer Science from the University of North Texas in 2011. After receiving my B.S., I served as UNIX Systems Lead for General Dynamics and the United States Air Force Central Command Intelligence, Surveillance, and Reconnaissance Division, where I provided subject matter expertise to the US military A6, G6, and J6 commands, foreign nations, as well as down-range assets. I also developed real-time self-service web services for the Change-Advisory Board.

7. Since 2015, I have worked for FMR LLC developing computer architecture and creating seamless user integration experiences while maintaining security. I supported the cloud management systems and developed automation resources to meet FMR LLC's strict security, compliance, and audit requirements. While working at FMR LLC, I earned my M.S. in Computer Science (2018) and Ph.D. in Computer Science and Engineering (2021) from the University of North Texas, where I wrote my thesis on an Extensible Computer Architecture Design for Connected Autonomous Vehicle Systems. After earning my Ph.D. I was promoted to Distinguished Engineer and now provide technical leadership for FMR LLC's Platform Engineering teams, develop next-gen frameworks for high-performance applications, and facilitate high-level and cross-business unit architecture teams.

8. Since 2021, I have served as Clinical Assistant Professor at the University of North Texas, where I have designed and taught undergraduate and graduate-level computer science, information technology, and cybersecurity courses. In addition to serving as the Computer

Science curriculum program advisor, I have led the NSA/NSF GenCyber student and teacher summer camps to help train and inspire the next generation of cybersecurity leaders.

9. Further details of my background and experience are provided in my curriculum vitae, which is attached as Appendix D. I am being compensated for my time at a rate of $500 per hour. My compensation does not depend on the outcome of this case or on any opinion that I may offer.

II. EXECUTIVE SUMMARY

10. Section III introduces the process that underlies web display advertising and the tools and platforms that facilitate this process, including ad servers, ad exchanges, ad buying tools and ad networks. Website owners, or publishers, generally use ad servers such as Google's DoubleClick for Publishers (DFP) to manage the ad slots on their websites. Ad exchanges, such as Google Ad Exchange (AdX), are marketplaces for publisher tools to put ad slots up for auction, while buy-side tools bid for their ads to be displayed. DFP and Google Ad Exchange are currently part of a single product, Google Ad Manager (GAM). Advertisers use ad buying tools such as Google Ads and DV360 to manage their ad campaigns and purchase ad slots in real-time.

11. Section IV first provides an overview of the ad serving stack and information flow during the ad serving process. Line items are specific settings and criteria in an ad server that define how, when, and where an advertisement will be delivered and at what cost. Ad tags are segments of code embedded on a publisher's website that communicate with a publisher's ad server to initiate the ad serving process when a user opens a website and to receive the winning advertisement and send it to the browser. User identifiers and information used for purposes such as ad targeting are collected via cookies and provided by publishers. BOW is Google's front-end server that receives requests sent by ad tags. Then the Unified Identity Server (UIS) performs authentication and sends the request to the "Supermixer," which is responsible for routing bid requests and collecting responses from demand sources. A series of targeting servers are responsible for selecting ads from specific demand sources and sending them, along with bid values, to the Supermixer. The relevant targeting servers include: 1) CAT2 mixer, which returns bids from Google buying tools (*e.g.*, DV360 and Google Ads), 2) RTB mixer, which returns bids from third-party buying tools bidding into AdX and Exchange Bidding, and 3) GFP mixer, which returns bids from direct deals with advertisers. When the Supermixer returns the winning ad, BOW is responsible for information formatting and ad rendering.

12. Further, Section IV describes additional capabilities of Google's ad buying tools. AWBid enables Google Ads to bid into third-party exchanges, in addition to Google's Ad Exchange and facilitates Project Yavin, which allows DV360 and Google Ads to buy directly from publishers' ad servers. Section IV then explains how Google's ad serving functionality has changed over time and how it functions today, including the transition away from waterfall to real-time auctions and the introduction of Dynamic Allocation, Enhanced Dynamic Allocation, Header Bidding, Exchange Bidding, and Unified Pricing Rules.

13. Section V describes how AdX was originally designed to be interoperable with third-party ad servers and ad networks. When Google rebuilt the AdX technology in 2009, it was designed to integrate with Google's ad stack (*e.g.*, AdSense, AdWords, DFP); however, publishers and advertisers could use AdX in conjunction with third-party buying tools, ad networks, and/or ad servers. Around 2014, Google began unifying DFP and AdX into a single platform, which culminated in the release of GAM in 2018. Google built a single UI to access both DFP and AdX, integrated DFP and AdX's ad serving infrastructure over time, and built additional features on top of the unified stack. AdX and DFP have separate ad tags (AdX tag and GPT tag, respectively). Google has considered several solutions to direct all GAM traffic through the GPT tag; however, AdX tags are still in use and advertisers are still able to use AdX with a third-party ad server (AdX Direct). While AdX tags and AdX Direct still exist, publishers using AdX tags do not have access to all the features of GPT tags, such as Programmatic Guaranteed, Preferred Deals, Dynamic Allocation, and Exchange Bidding.

14. Section VI describes how Dynamic Allocation (DA) was launched by DoubleClick in 2007. DA enabled AdX and remnant, or non-guaranteed, line items to compete in real-time for impressions not fulfilled by guaranteed line items. At the time, waterfall auctions were used to sell ad slots, where demand sources (*i.e.*, ad exchanges and networks) were ranked in order of historical performance and called sequentially to solicit bids until a demand source provided a suitable ad. This resulted in several inefficiencies, including latency and situations where a publisher may not have maximized their revenue for an impression. With DA, if no guaranteed line item provided a suitable ad, AdX and remnant line items would compete against each other and the winning ad would be served. In the event that there was no eligible remnant line item or a winning AdX candidate, the publisher would promote its own products or services. When DA was launched, AdX was the only exchange with the technical capability to submit real-time bids into DFP, and therefore, participate in DA. Google acquired a "yield manager" platform in 2011 called AdMeld that supported real-time bidding (RTB), (*i.e.*, handling bids from multiple demand

sources to compete in a single real-time auction). After acquiring AdMeld, Google began developing "Third-Party Dynamic Allocation" (3PDA), which would have allowed AdX buyers to compete with demand sources engaging in real-time bidding through AdMeld in an AdMeld-hosted auction for AdMeld publisher inventory. However, Google ultimately did not release 3PDA.

15. Section VII describes how Google introduced Enhanced Dynamic Allocation (EDA) in March 2014, which allowed AdX and remnant line items (*e.g.*, third-party exchanges) to compete against guaranteed line items in real-time, while still protecting guaranteed line items' campaign goals. With EDA, publishers may have lost out on revenue from guaranteed and remnant demand sources because while AdX competed for impressions with real-time bids, guaranteed and remnant line items competed using static CPMs. Google transitioned all publishers to EDA by 2016 and did not offer a direct way for publishers to disable or turn off EDA. To circumvent EDA, a publisher could either disable AdX for a single impression or use AdX tags, which are limited in functionality. Within EDA, DFP used remnant line items, which were selected to compete using real-time bids from external third-party buyers, to calculate AdX's price floor. This gave AdX buyers a "Last Look" at other buyers' prices before submitting bids. Last Look led to situations where AdX won auctions that it would have otherwise lost without Last Look. However, Google did not use bids from third-party buyers bidding through Google's own products to inform AdX auction price floors in Last Look. I understand that EDA is still in use today, and that in 2019 Google effectively removed the Last Look from EDA.

16. Section VIII discusses how in 2014, Header Bidding was introduced to resolve the technical challenges associated with waterfall auctions and to promote real-time bidding outside of Google's ad stack. Header Bidding allowed publishers to offer their ad inventory to multiple exchanges simultaneously. Hence, publishers were able to select the winner based on the highest real-time bid, instead of the bidders' historical performance. Header Bidding is implemented by placing HTML or JavaScript code on a publisher's website, which runs an auction for different demand sources before sending the winning bid to the ad server. Header Bidding can be of two types – client-side and server-side – based on whether it is run on the user's browser or an external server. Winning Header Bidding bids are sent into GAM as line items and compete with AdX buyers in real-time. Since Header Bidding bids are usually matched to remnant line items, AdX buyers had a Last Look over Header Bidding buyers until 2019 when Last Look was removed.

17. Section IX describes the introduction of Exchange Bidding by Google in 2018 as its server-side alternative to Header Bidding. With Exchange Bidding, a single bid request is sent from the publisher webpage to Google Ad Manager, which then sends bid requests to all participating bidders, including both AdX and third-party exchanges, to compete in a single real-time auction. Exchange Bidding was implemented on an external server to purportedly reduce latency according to Google. But this server-side implementation also resulted in reduced visibility into the auction dynamics on the external server. I understand that unlike buyers using Header Bidding, the bids of buyers using Exchange Bidding were not used to inform the AdX floor. Moreover, Exchange Bidding participants were also granted the Last Look over Header Bidding bids.

18. Section X discusses the introduction of Project Bernanke, an internal Google program, in 2013 to adjust advertiser bids and increase the numbers of auctions won by Google Ads in AdX. Project Bernanke was implemented in four phases – "Original Bernanke" in 2013, "Global Bernanke" in 2015, "Project Bell v2" in 2016 and "1P Bernanke" in 2019. Original Bernanke, Global Bernanke, and 1P Bernanke all maintained Bernanke pool(s) of money to subsidize bids in auctions where Google Ads bids would have lost, and recouped money through bid adjustments in auctions where bids from Google Ads bidders ranked on top. Google employed a series of background experiments to calculate the multipliers used to adjust the bids sent by Google Ads. The original version of Project Bernanke adjusted bids while creating a Bernanke pool per publisher and maintained a fixed margin per publisher. Global Bernanke changed the per-publisher pool to a single pool shared among all publishers. Finally in 2019, Google adjusted the Bernanke algorithm to accommodate the switch to a first-price auction.

19. Section XI discusses Google's launch of Dynamic Revenue Share (DRS) in 2015, which modified the take rate in AdX auctions to clear more auctions. Google released three versions of DRS. DRS v1 lowered the AdX take rate if that allowed the highest AdX bid to clear the auction. DRX v2, launched in December 2016, allowed Google to raise the AdX take rate to counterbalance the auctions in which the take rate was lowered by DRS. Finally, Truthful DRS (tDRS) launched in July 2018 and employed a machine learning model to predict the AdX revenue share that was necessary for the highest bid to clear the auction.

20. Section XII describes Project Poirot, launched in 2017, that reduces DV360 spend in second-price auctions[1] with "soft" floors, which are floors that allow bids below the floor to win.

[1] In a second-price auction, the highest bidder wins but pays the amount of the second-highest bid.

Project Poirot is designed to detect deviations from second-price auctions and have DV360 bid less in those exchanges. Google runs daily background experiments for each advertiser and exchange pairing and uses a machine learning algorithm trained on seven days of DV360 data to determine the amount to lower a bid. Google launched additional versions of Project Poirot, including Poirot with Bid Buckets, Poirot with Auction Type Signal, and a version incorporating minimum bid to win data from GAM. Google has also extended Poirot to run on AdWords (an older version of Google Ads) and has launched Project Marple, which applies the same methodology to Google Ads.

21. Section XIII discusses how Google introduced multiple versions of Reserve Price Optimization (RPO) to automatically increase auction reserve prices that Google predicts are too low compared to the value of publisher inventory. Google uses machine learning models to set the increased auction reserve prices as close to the expected highest bid as possible while clearing their margin requirements to ensure the transaction completes. There were two types of RPO: second-price RPO, which was a no opt-out feature that functioned from 2015 until 2019 and first-price RPO which is an optional feature that was rolled out in 2022 and functions to this day. Second-price RPO generated per-buyer reserve prices for second-price auctions. First-price RPO was rolled out following Google's switch to first-price auctions and operates similarly while accounting for changed bidder behavior.

22. Section XIV discusses Unified Pricing Rules (UPR), which were introduced in 2019 and accompanied Google's shift from a second-price auction in AdX to a unified first-price auction where bids from all demand sources in GAM competed at the same time. UPR introduced several changes to Google's auction dynamics with regards to how publishers could set price floors (also known as "pricing rules"). Prior to UPR, publishers could set price floors for each buyer and advertiser through GAM; set price floors for a third-party exchange by using that exchange's platform; assign a priority for each price floor to dictate which floor would take precedence if two floors overlapped with each other during an auction; and specify how much information about the webpage visited by the user could be shared with buyers. However, prior to UPR, publishers could not use GAM to configure price floors for third-party exchanges, and would have to set price floors for these exchanges through an interface provided by the exchange. The launch of UPR resulted in uniform price floors that applied to all buyers; as a result, publishers could no longer set per-buyer price floors. Similarly, publishers were more limited in the number of price floors that could create per GAM account and in the amount of information they could share with buyers.

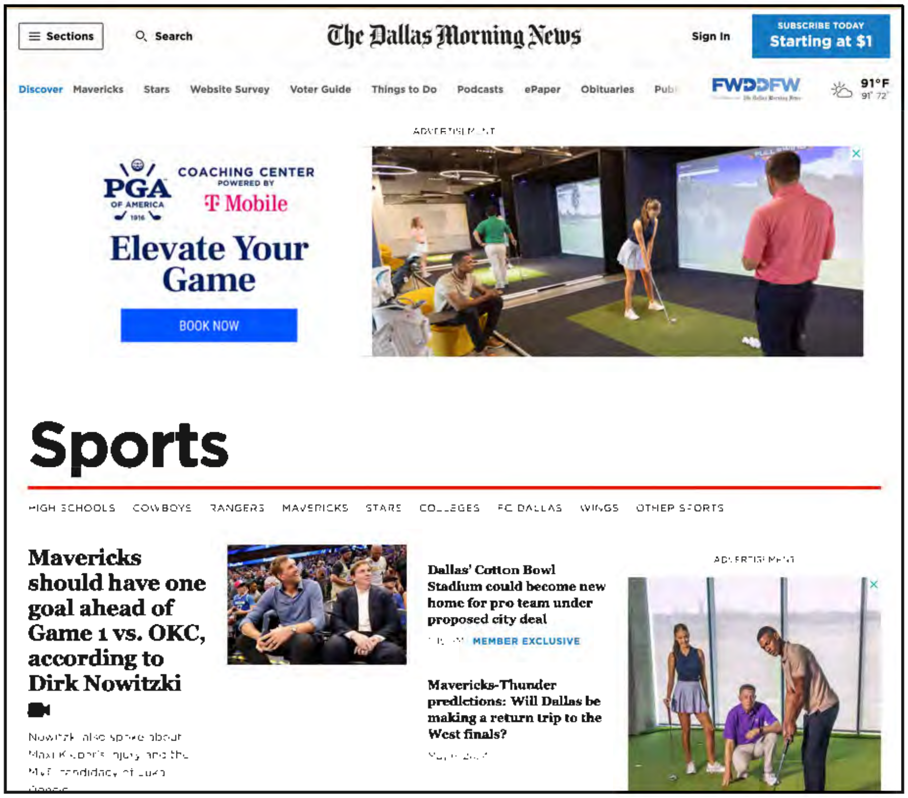
Some publishers attempted to circumvent UPR using "house" line items, but Google updated its line item policy to prevent what it called "invalid activity" from publishers bypassing UPR.

III. INTRODUCTION TO WEB DISPLAY ADVERTISING TECHNOLOGY

23. When a user navigates to a website that displays advertisements, such as an online news publisher, the ads that the user sees on that webpage are the result of an automatic ad selection process that runs in real-time as the page loads.[2] This ad selection process often involves a real-time ad auction.[3] The owner of the website allocates a number of "slots" on each page, each of which can contain an ad.[4] When an individual user sees an ad that is placed in a slot, it is called an "impression."[5] In display advertising auctions, advertisers bid for the chance to have their ad shown on a particular webpage in a particular slot to a particular user (generally someone in their target audience).[6] A number of ad technology products are involved in sending requests for ads to the auction, selecting the winning bidder, and showing the winning ad to the user.[7] Figure 1 shows an example of a winning advertisement, in this case an ad for the Professional Golfers' Association of America on the Sports page of the Dallas Morning News. This section of my report discusses the ad serving process, as well as the platforms and tools that facilitate this process.

[2] Khor N., Publift, "What is Programmatic Advertising? How Does it Work?" (April 8, 2024) https://www.publift.com/adteach/what-is-programmatic-advertising. Accessed May 23, 2024.
[3] Khor N., Publift, "What is Programmatic Advertising? How Does it Work?" (April 8, 2024) https://www.publift.com/adteach/what-is-programmatic-advertising. Accessed May 23, 2024.
[4] Clearcode, "Ad slot," https://clearcode.cc/glossary/ad-slot-definition/. Accessed May 23, 2024.
[5] adjust, "What is an impression?" https://www.adjust.com/glossary/impression/. Accessed April 23, 2024.
[6] Khor N., Publift, "What is Programmatic Advertising? How Does it Work?" (April 8, 2024) https://www.publift.com/adteach/what-is-programmatic-advertising. Accessed May 23, 2024.
[7] Khor N., Publift, "What is Programmatic Advertising? How Does it Work?" (April 8, 2024) https://www.publift.com/adteach/what-is-programmatic-advertising. Accessed May 23, 2024.

Figure 1: An ad for PGA America on the Sports page of the Dallas Morning News

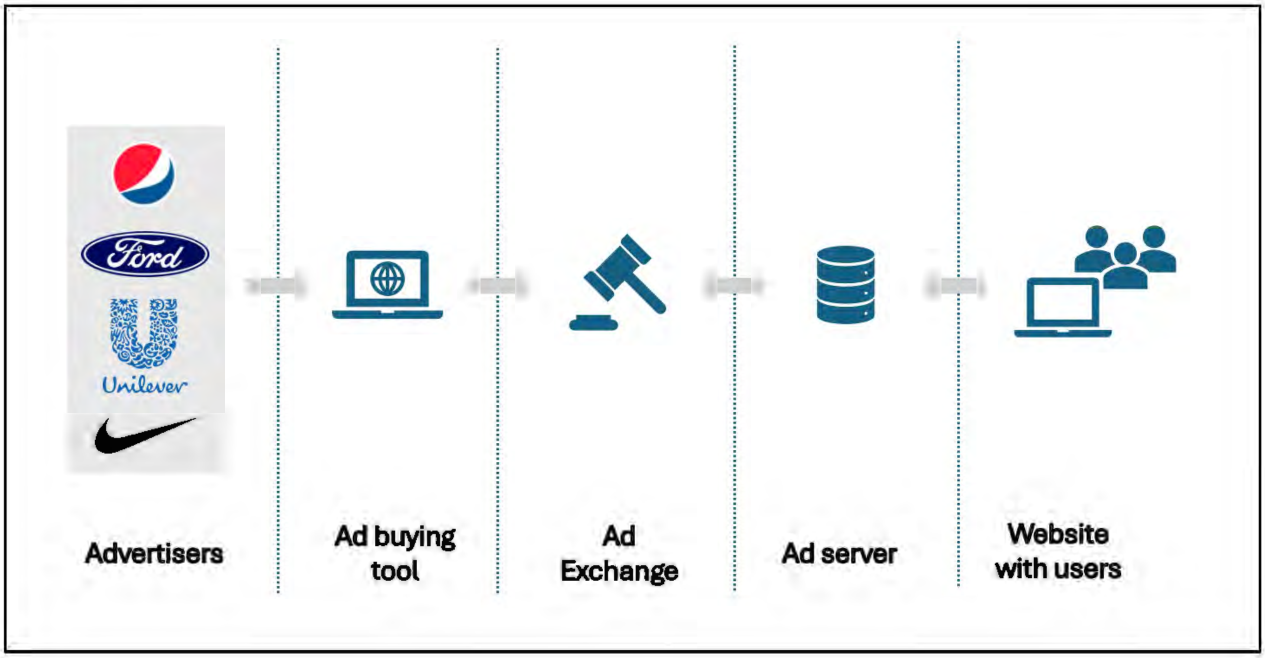


24. Various advertising technology platforms and tools facilitate the ad serving process, including publisher ad servers, ad buying tools, and ad exchanges.[8] Figure 2 provides an overview of the process of serving an advertisers' ad via an ad exchange to a user visiting a publisher's website. Website owners, also known as publishers, use ad servers to manage their display ad inventory (the various slots on their webpages that can display ads) and to find ads to fill those slots (referred to as "demand" in the display advertising industry).[9] Advertisers use ad buying tools to manage their display ad campaigns, designate user targeting criteria for their advertisements (*e.g.*, based on demographics, geography, online behavior etc.), and set goals for their ad campaigns.[10] An ad campaign is a set of related advertisements with the same objectives,

[8] Urwin M., builtin, "Adtech Definition," (Sept 27, 2022) https://builtin.com/adtech-martech. Accessed May 23, 2024.
[9] Amazon Ads, "Ad Servers and how they work," https://advertising.amazon.com/library/guides/ad-server. Accessed June 5, 2024.
[10] As described in Section III.C, ad buying tools can include buying tools for large advertisers, sometimes referred to as DSPs, and buying tools for small advertisers such as Google Ads; Description of capabilities of DSPs, adjust, "What is a demand-side platform (DSP)?" https://www.adjust.com/glossary/demand-side-platform/. Accessed May 23, 2024; Examples of set-up pages from different buyside tools: Trade Desk: Partner portal, "Campaign," https://partner.thetradedesk.com/v3/portal/api/doc/Campaign. Accessed May 23, 2024; Google Ads: Google Ads Help, "Create a campaign,"

budget, dates, and conversion events.[11] For example, an advertiser may set up a display ad campaign with the objective of getting as many site visits as possible between the dates of January 1st and February 1st by 20- to 40-year-old women who are interested in golf and located in Dallas, TX. Google's ad buying tools allow an advertiser to specify a campaign type or creative type (*e.g.*, Display Campaign or Video Campaign) based on the campaign's goals.[12] Ad exchanges primarily facilitate programmatic ad deals, such as by conducting ad auctions where publishers and advertisers connect to buy and sell impressions.[13,14]

Figure 2: Overview of the ad serving process via an ad exchange[15]



https://support.google.com/google-ads/answer/6324971. Accessed May 21, 2024; DV360: Display & Video 360 Help, "Create a campaign," https://support.google.com/displayvideo/answer/7205081. Accessed May 23, 2024.

[11] Examples of set-up pages from different buyside tools: Trade Desk: Partner portal, "Campaign," https://partner.thetradedesk.com/v3/portal/api/doc/Campaign. Accessed May 21, 2024.

[12] Google Ads: Google Ads Help, "Create a campaign," https://support.google.com/google-ads/answer/6324971. Accessed May 21, 2024; DV360: Display & Video 360 Help, "Create a campaign," https://support.google.com/displayvideo/answer/7205081. Accessed May 21, 2024.

[13] The Trade Desk, "Glossary," https://www.thetradedesk.com/us/glossary. Accessed June 5, 2024.

[14] Amazon Ads, "What is an ad exchange? Learn how they work," https://advertising.amazon.com/library/guides/ad-exchange. Accessed June 5, 2024.

[15] This is meant to serve as a simplified overview of the ad serving process via ad exchange, based on an internal Google document, "SF Programmatic Primer," GOOG-AT-MDL-003565982 at '994 (CI).

25. Google owns and operates all three of the advertising technology products described above. Namely, Google owns a publisher ad server called DoubleClick for Publishers,[16] an ad exchange called Google Ad Exchange and two ad buying tools, Google Ads and DV360.[17]

26. Ad networks act as an intermediary that buys ad inventory from publishers in bulk and sells it to advertisers, as opposed to ad exchanges that function more as a marketplace.[18,19] Google's ad network includes Google Display Network (GDN), which advertisers can use to run display campaigns, and AdSense, the publisher-facing tool in Google's ad network.[20,21,22] AdSense fills publisher ad slots with demand from Google Ads (Google's ad buying tool for small advertisers), DV360 (Google's ad buying tool for large advertisers), and third-party buyers in AdX.[23] AdSense is less sophisticated in its ad-serving capabilities than DFP and offers less diversity of ad sources; however, it is designed to be easy to set up and can be used by small publishers with less sophisticated ad campaigns.[24]

A. Ad servers: publishers' tools for managing and selling inventory

27. A publisher operating a website has the option to monetize their display inventory by either utilizing an ad server or an ad network.[25] An ad server is a software platform that manages and distributes publishers' display inventory by keeping a record of their direct deals with

[16] DoubleClick for Publishers and Google Ad Exchange are currently marketed together under the name "Google Ad Manager." Internal Google documents as well as some industry sources still refer to the products separately. Where it is necessary for clarity, I refer to the two products as separate in this report. Bellack J., Google Ad Manager, "Introducing Google Ad Manager," (June 27, 2018) https://blog.google/products/admanager/introducing-google-ad-manager/. Accessed May 23, 2024.
[17] [redacted] Deposition, (April 26, 2024) at 263:18-21; [redacted] Deposition, (April 26, 2024) at 23:2-10.
[18] The Trade Desk, "Glossary," https://www.thetradedesk.com/us/glossary. Accessed June 5, 2024.
[19] Amazon, "What is an ad exchange? Learn how they work," https://advertising.amazon.com/library/guides/ad-exchange. Accessed June 5, 2024.
[20] Google Ads is often referred to in internal documents as "AdWords" or "Google Display Network" (GDN). Some documents refer to GDN as AdSense and Google Ads together, while others refer GDN as just Google Ads. [redacted] Deposition, (April 19, 2024) at 23:16-17; Google internal document, "Google Display Network Launch," GOOG-TEX-00820709 at '710 and '714 (HCI).
[21] Google Ads Help, "About Display ads and the Google Display Network," https://support.google.com/google-ads/answer/2404190. Accessed June 6, 2024.
[22] Google internal document, "AViD Serving Architecture (Backend)," (December 18, 2023) GOOG-AT-MDL-B-005180695 at '698 (HCI).
[23] Google internal document, "AViD Serving Architecture (Backend)," (December 18, 2023) GOOG-AT-MDL-B-005180695 at '698 (HCI).
[24] Zaiceva A., setupad, "Google AdX vs. Google AdSense | Difference Explained," (December 16, 2021) https://setupad.com/blog/adsense-vs-ad-exchange/. Accessed May 30, 2024; [redacted] Deposition, (April 26, 2024) at 264:16-265:15.
[25] Playwire, "Ad Server vs. Ad Network," https://www.playwire.com/blog/ad-server-vs-ad-network. Accessed May 23, 2024.

advertisers, routing available inventory to ad exchanges, and determining which ad to show in real-time.[26] Google owns a publisher ad server called DoubleClick for Publishers (DFP).[27]

28. A key role of an ad server is to determine the ads that will be displayed on the publisher's website. To achieve this, an ad server typically performs three critical tasks: (1) collecting information about the users visiting the publisher webpage and passing it down the ad tech "stack," (2) routing publisher inventory to direct and indirect demand sources, and (3) selecting the winning ad and communicating the information back to the web browser.[28,29]

29. First, the ad server collects information on the user visiting the webpage through a browser-facilitated identification technology called "cookies."[30] Cookies are small files or pieces of data stored on a user's device that allow websites and services the user interacts with online to identify or authenticate the user.[31] Cookies may also contain user-specific information, including login credentials and browsing history.[32] They are collected and used by ad servers to track users' online behavior over time and display targeted ads tailored to the individual's interests and preferences.[33] For example, if a user, who has been classified as "interested in athletics" based on their browsing history, views an article in online Runner's World magazine, the ad server used by Runner's World may serve the user an Adidas sneaker ad.

30. Second, the ad server allocates and routes publishers' inventory across direct and indirect demand sources.[34] Direct demand represents direct agreements between the publisher and advertisers, often involving a specific negotiated price and an agreed-upon volume or percentage

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26 Amazon Ads, "Ad Servers and how they work," https://advertising.amazon.com/library/guides/ad-server. Accessed June 5, 2024.
27 AdSense is out-of-scope for this report but is mentioned here to explain the serving stack and certain programs.
28 Sweeney M., Zawadzinski M., clearcode, "What is an Ad Server and How does it work," (March 14, 2024) https://clearcode.cc/blog/what-is-an-ad-server/. Accessed May 23, 2024.
29 There are other ways a publisher ad server can collect publisher information such as PPID, which is described in detail in Section IV.C. Google Ad Manager Help, "About publisher provided identifiers," https://support.google.com/admanager/answer/2880055. Accessed May 23, 2024.
30 Barth A., Internet Engineering Task Force (IETF) Request for Comments (RFC) 6265, "HTTP State Management Mechanism" (April 2011) https://datatracker.ietf.org/doc/html/rfc6265. Accessed June 5, 2024.
31 [redacted] Deposition, (May 3, 2024) at 527:17-23.
32 Mozilla Support Firefox Help, "Cookies - Information that websites store on your computer" (July 29, 2023) https://support.mozilla.org/en-US/kb/cookies-information-websites-store-on-your-computer. Accessed June 5, 2024.
33 Amazon Customer Service, "About Cookies" (January 1, 2020) https://www.amazon.com/gp/help/customer/display.html?nodeId=GV. Accessed June 5, 2024.
34 Sweeney M., Zawadzinski M., clearcode, "What is an Ad Server and How does it work," (March 14, 2024) https://clearcode.cc/blog/what-is-an-ad-server/. Accessed May 23, 2024.

of ads to be displayed within a designated timeframe.[35] Such agreements can be negotiated under varying terms.[36] Traditional direct demand involved purchasing ad inventory at a fixed price and managing the insertion of the ad manually. In contrast, "programmatic direct" involves an agreement between publishers and advertisers, but the process of selecting the ad based on targeting and placing the ad on the publisher's website is performed automatically.[37] For example, publishers and advertisers can negotiate a "Programmatic Guaranteed" deal. In this case, the publisher and the advertiser negotiate terms and price for a given segment of the publisher's inventory, which is then guaranteed to be sold to that advertiser at that price.[38] For instance, a publisher may make a deal with Nike that guarantees that Nike ads will be shown on 50% of publisher's ad space in the span of a month at a price of $5.00 for every 1000 impressions. Publishers and advertisers can also negotiate a "Preferred Deal," where both parties similarly agree on terms and a price for specific inventory. However, unlike Programmatic Guaranteed, there is no binding obligation for the publisher to sell or the advertiser to buy said inventory. In other words, the advertiser has a "preferred" opportunity to place a bid for the inventory before other demand sources, but the inventory is not reserved for that advertiser, nor is the advertiser required to buy it.[39] Both types of direct deals may be recorded in the ad server, which then determines the optimal way to allocate inventory and display ads.[40] Programmatic Guaranteed and Preferred Deals are collectively referred to as "Programmatic Direct," denoting the programmatic (or automatic) sale of ad inventory negotiated through direct deals.[41]

31. In contrast, indirect (or "Programmatic") demand represents buyers that do not have a direct relationship or agreement with the publisher and instead compete for the publisher's

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[35] Munro B., Publift, "What is Programmatic Direct," (April 8, 2024) https://www.publift.com/blog/what-is-programmatic-direct. Accessed April 11, 2024; Google Ad Manager Help, "Programmatic Guaranteed vs. Preferred Deals," https://support.google.com/admanager/answer/7637485. Accessed May 23, 2024.
[36] Munro B., Publift, "What is Programmatic Direct," (April 8, 2024) https://www.publift.com/blog/what-is-programmatic-direct. Accessed April 11, 2024; Google Ad Manager Help, "Programmatic Guaranteed vs. Preferred Deals," https://support.google.com/admanager/answer/7637485. Accessed May 23, 2024.
[37] Seth A., adpushup, "Programmatic Deals vs. Direct Deals – Simplified Advertising Comparison," (March 29, 2024) https://www.adpushup.com/blog/programmatic-vs-direct-deal/. Accessed May 23, 2024.
[38] Google Ad Manager Help, "Programmatic Guaranteed vs. Preferred Deals," https://support.google.com/admanager/answer/7637485. Accessed May 23, 2024.
[39] Google Ad Manager Help, "Programmatic Guaranteed vs. Preferred Deals," https://support.google.com/admanager/answer/7637485. Accessed May 23, 2024.
[40] Munro B., Publift, "What is Programmatic Direct," (April 8, 2024) https://www.publift.com/blog/what-is-programmatic-direct. Accessed May 23, 2024; Sweeney M., Zawadzinski M., clearcode, "What is an Ad Server and How does it work," (March 14, 2024) https://clearcode.cc/blog/what-is-an-ad-server/. Accessed May 23, 2024.
[41] Munro B., Publift, "What is Programmatic Direct," (April 8, 2024) https://www.publift.com/blog/what-is-programmatic-direct. Accessed May 23, 2024.

inventory via auctions.[42] If any segment of publisher ad space is not filled via a direct deal with an advertiser, the ad server solicits bids from indirect channels. [43] In this process, a request is sent to different ad exchanges and networks to solicit bids from other demand sources.[44] A "price floor," alternatively known as "floor price" or "reserve price," denotes the minimum amount a publisher is willing to accept for a particular ad placement.[45] This value, typically configured through the ad server interface, is included in each request to let the demand sources know the minimum price they must beat for their bid to be eligible to compete in the auction.[46]

32. Finally, once the ad server receives all the bids, it determines the final winner among all ads aggregated from the different sources. The winning ad is sent back to the browser, which in turn, renders the ad and makes it visible to the user.[47]

33. In addition to determining which ads are displayed on a publisher website, ad servers provide publishers with insights into the performance of ads served on their website, including the number of ads that are displayed on a particular page and amounts paid by advertisers for the corresponding impressions. Ad servers may also provide forecasting information projecting a publisher's sales and website users, along with other capabilities, such as algorithms that can help publishers intelligently set the price minimums for their inventory.[48]

34. Publisher websites communicate with ad servers using "ad tags." Ad tags are pieces of code inserted into the publisher webpage that are executed by a user's browser as part of loading the

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[42] Seth A., adpushup, "Programmatic Deals vs. Direct Deals – Simplified Advertising Comparison," (March 29, 2024) https://www.adpushup.com/blog/programmatic-vs-direct-deal/. Accessed May 23, 2024.

[43] In reality, this is slightly more complicated. Programs such as DA and EDA, described in Sections VI and VII, may determine that a bid from AdX should serve, even if a direct deal line items is available. Sweeney M., Zawadzinski M., clearcode, "What is an Ad Server and How does it work," (March 14, 2024) https://clearcode.cc/blog/what-is-an-ad-server/. Accessed May 23, 2024.

[44] Vaibhav P., aniview, "What is an ad server? How does ad serving work?" (April 20, 2023) https://aniview.com/what-is-an-ad-server-how-does-ad-serving-work/. Accessed May 23, 2024.

[45] headerbidding, "Price Floor Optimization – a Guide for Publishers," (February 20, 2024) https://headerbidding.co/price-floor-optimization/. Accessed May 23, 2024.

[46] headerbidding, "Price Floor Optimization – a Guide for Publishers," (February 20, 2024) https://headerbidding.co/price-floor-optimization/. Accessed May 23, 2024.

[47] Sweeney M., Zawadzinski M., clearcode, "What is an Ad Server and How does it work," (March 14, 2024) https://clearcode.cc/blog/what-is-an-ad-server/. Accessed May 23, 2024.

[48] Zaiceva A., setupad, "What is an Ad Server & 10 Best Ad Servers for Publishers," (April 17, 2024) https://setupad.com/blog/ad-server/. Accessed May 23, 2024; GAM provides floor optimization algorithms like target CPMs and optimized floors and a variety of metrics that can be included in reports. *See* Google Ad Manager Help, "Unified pricing rules," https://support.google.com/admanager/answer/9298008. Accessed May 23, 2024; Google Ad Manager Help, "Ad Manager report metrics," https://support.google.com/admanager/table/7568664. Accessed May 23, 2024.

webpage.[49] Generally, the ad server generates the code for an ad tag via the ad server interface and the publisher places the tag within the code on their page.[50] When a user opens the publisher's website, the ad tag is activated and sends a signal to the publisher ad server with a request for ads.[51] Ad tags are described in detail in Section IV.B.

35. DoubleClick for Publishers (DFP)[52] is Google's ad server that is used by larger publishers with a significant number of direct advertisement sales.[53] DFP is currently part of Google Ad Manager (GAM) along with Google's Ad Exchange, which is described in detail in Section III.B.[54] GAM offers two plans: GAM small business and GAM 360, which are designed for medium-large publishers and enterprise-size publishers, respectively.[55] GAM 360 is available to publishers with more than 90 million monthly impressions, requires a contract with Google, and offers a variety of reporting and ad auction features that are not available to GAM small business customers.[56]

36. Publishers using DFP set up their ad inventory and create "line items" to represent their transactions, both from direct deals with advertisers and ad agencies and from ad networks and exchanges, as described in detail in Section IV.A.[57] Publishers define spaces on their website designated for ads and use DFP to generate Google ad tags to place on their website.[58] To determine which exchanges and networks can bid on segments of their inventory, publishers

[49] Seth A., adpushup, "What are Ad Tags and Why Do They Matter," (March 29, 2024) https://www.adpushup.com/blog/ad-tags/. Accessed May 23, 2024.
[50] Munro B., Publift, "Ultimate Guide to Ad Tags," (March 20, 2024) https://www.publift.com/blog/ultimate-guide-to-ad-tags. Accessed May 23, 2024.
[51] Munro B., Publift, "Ultimate Guide to Ad Tags," (March 20, 2024) https://www.publift.com/blog/ultimate-guide-to-ad-tags. Accessed May 23, 2024.
[52] Now combined with AdX to form Google Ad Manager (GAM).
[53] "Google Ad Manager is an ad management platform for large publishers who have significant direct sales." Google Ad Manager Help, "Compare Ad Manager, AdSense, and AdMob," https://support.google.com/admanager/answer/9234653. Accessed May 23, 2024.
[54] Bellack J., Google Ad Manager, "Introducing Google Ad Manager," (June 27, 2018) https://blog.google/products/admanager/introducing-google-ad-manager/. Accessed May 23, 2024.
[55] Abhilasha, headerbidding, "Google Ad Manager or Google Ad Manager 360 – What Should a Publisher Choose?" (December 20, 2023) https://headerbidding.co/google-ad-manager-vs-ad-manager-360/. Accessed May 23, 2024.
[56] Abhilasha, headerbidding "Google Ad Manager or Google Ad Manager 360 – What Should a Publisher Choose?" (December 20, 2023) https://headerbidding.co/google-ad-manager-vs-ad-manager-360/. Accessed May 23, 2024.
[57] Google Ad Manager Help, "Advertising with Google Ad Manager," https://support.google.com/admanager/answer/6022000. Accessed May 23, 2024; Google Ad Manager Help, "Line item types and priorities," https://support.google.com/admanager/answer/177279. Accessed May 23, 2024.
[58] Google Ad Manager Help, "Advertising with Google Ad Manager," https://support.google.com/admanager/answer/6022000. Accessed May 23, 2024.

utilize "yield groups" within DFP.[59] More specifically, they can select inventory types and ad formats within each yield group and specify which ad exchanges, including Google Ad Exchange and third-party exchanges, and ad networks can bid on the inventory in that group.[60]

37. Within DFP, publishers can set fixed floors or use one of DFP's "floor optimization" options that allow publishers to relinquish some or all control over setting their floors to Google.[61] The floors sent to ad exchanges and ad networks are ultimately determined using a combination of publisher-configured values as well as values calculated by various applicable programs within DFP.[62] A detailed overview of the evolution of pricing floors and what has factored into their calculation is described in Section XIV.

38. DFP publishers can view various reports and metrics on the performance of ads on their website and receive payment for displaying the ads.[63] For example, a "historical report" within DFP would include data on clicks, revenue, click-throughs, and total impressions for select date ranges in the past, while a "future sell-through report" would include predicted impression data for dates in future.[64] Publishers using DFP are generally paid for the number of ads shown on their website once per month.[65]

B. Ad Exchanges: Marketplaces for transacting web display inventory

39. Ad exchanges are a type of ad technology used to buy and sell ad impressions in real-time.[66] Ad exchanges are analogous to digital auction houses, where ad servers and other publisher tools put impressions up for auction, while buy-side tools place bids for their ads to be displayed in that space. One common way ad exchanges generate revenue is by collecting a

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[59] Google Ad Manager Help, "Create and manage yield groups," https://support.google.com/admanager/answer/7390828. Accessed May 23, 2024.
[60] Google Ad Manager Help, "Create and manage yield groups," https://support.google.com/admanager/answer/7390828. Accessed May 23, 2024.
[61] Google Ad Manager Help, "Unified pricing rules," https://support.google.com/admanager/answer/9298008. Accessed May 23, 2024.
[62] Examples of these programs include reserve price optimization (RPO), First Look, and others.
[63] Google Ad Manager Help, "Create a new report," https://support.google.com/admanager/answer/2643320. Accessed May 23, 2024; Google Ad Manager Help, "Payment rules," https://support.google.com/admanager/answer/2671028. Accessed May 23, 2024.
[64] Google Ad Manager Help, "Report types in Ad Manager," https://support.google.com/admanager/answer/10117711. Accessed May 23, 2024.
[65] Publisher are paid if they reach their account threshold, if not the balance rolls over to the next month and is paid to the publisher once the threshold is met. Google Ad Manager Help, "Line item types and priorities," https://support.google.com/admanager/answer/177279. Accessed May 23, 2024.
[66] Munro B., Publift, "What is an Ad Exchange and How Does it Work?" (March 20, 2024) https://www.publift.com/blog/what-is-an-ad-exchange. Accessed May 23, 2024.

percentage of the clearing price (*i.e.*, the price at which the publisher is willing to sell and the advertiser is willing to buy) in the auction, similar to the fee that an auctioneer or an auction house charges when conducting an auction of physical goods.[67] This fee charged by the ad exchange is often referred to as a "take rate" or "revenue share."[68]

40. Ad exchanges help facilitate real-time bidding (RTB), which is the process of buying and selling advertisements in an instantaneous auction as the page loads.[69] Prior to real-time bidding, advertisers primarily made direct deals with publishers to purchase ad slots in bulk. These deals specified the ad space, volume, timeframe, and a pre-determined price for which the advertiser's ads would be displayed on the publisher's webpage.[70]

41. With the introduction of real-time bidding in 2009, advertisers have had the option to continue making direct deals with publishers or to bid for an opportunity to display their ad to a particular user at the very moment the user visits the publisher webpage. Therefore, with real-time bidding, publishers and advertisers have additional information about the ad slot, such as information about the user expected to view the ad. This enables the ad space to be sold at varying prices based on its perceived value.[71] The process of real-time bidding occurs in the time span of approximately 100 milliseconds.[72]

42. After the introduction of real-time bidding, to meet their contractual obligations, publishers would prioritize the sales of directly negotiated inventory first. Any remaining ad space would be routed to ad networks and ad exchanges, which were called sequentially in an order determined by the publisher until one was able to meet the price floor and return a qualifying ad.[73] This process is referred to as the waterfall process, which I explain in further detail in Section IV.J. After the waterfall model, several ad selling models, such as Header Bidding, were developed

[67] Greenfield I., mntn, "Ad Exchange: What Is It and How Does it Work?" https://mountain.com/blog/what-is-an-ad-exchange/. Accessed May 23, 2024.
[68] [redacted] Deposition, (April 26, 2024) at 180:16-181:12.
[69] Munro B., Publift, "What is an Ad Exchange and How Does it Work?" (March 20, 2024) https://www.publift.com/blog/what-is-an-ad-exchange. Accessed May 23, 2024.
[70] Titone T., ad tech explained, "Real-Time Bidding Explained – How do ad auctions work?" (August 22, 2021) https://adtechexplained.com/real-time-bidding-explained/. Accessed May 30, 2024.
[71] Flanagan J., adtaxi, "The Origins and Progression of Real-Time Bidding," (March 15, 2018) https://www.adtaxi.com/blog/origins-progression-real-time-bidding/. Accessed May 23, 2024.
[72] Flanagan J., adtaxi, "The Origins and Progression of Real-Time Bidding," (March 15, 2018) https://www.adtaxi.com/blog/origins-progression-real-time-bidding/. Accessed May 23, 2024.
[73] Bigabid, "Waterfall vs. Header Bidding, Everything you Need to Know," https://www.bigabid.com/waterfall-vs-header-bidding/. Accessed May 23, 2024.

that allowed calling multiple exchanges at the same time, which I explain in further detail in Section VIII.[74]

43. There are several different types of auctions, but the two most common types used by exchanges are variants of "first-price" and "second-price" auctions. In a first-price auction, the highest bidder wins if their bid is above the auction floor, and the bidder pays what they bid.[75] Figure 3 shows the two possible outcomes of a first-price auction. On the left, the advertiser Alice is the highest bidder, and their bid is greater than the floor value. Therefore, Alice wins and pays exactly what they bid. If the highest advertiser's bid is below the floor, there is no winner in the auction as shown in the bar chart on the right side.

44. In a second-price auction, the highest bidder also wins but pays the amount of the second-highest bid.[76] Figure 4 illustrates an example of a second-price auction. Suppose that advertisers Alice and Bob are the two highest bidding advertisers in an auction. If both Alice's bid and Bob's bid are above the floor, as shown in the leftmost bar chart, the higher bidder wins and pays the value of the second-highest bid. If the highest bid is above the floor, but the second-highest bid is below the floor, as shown in the middle figure, the highest bidding advertiser wins and pays the value of the floor. If both bids are below the floor, then neither advertiser wins, as shown in the rightmost bar chart.

[74] Bigabid, "Waterfall vs. Header Bidding, Everything you Need to Know," https://www.bigabid.com/waterfall-vs-header-bidding/. Accessed May 23, 2024.
[75] [redacted] Deposition, (April 26, 2024) at 249:25-251:7; Expert Report of Matthew Weinberg, June 7, 2024, para. 18 [*hereinafter* Weinberg Report].
[76] [redacted] Deposition, (April 26, 2024) at 249:25-251:7; [redacted] Deposition, (April 26, 2024) at 19:2-7; Weinberg Report, para. 18.

Figure 3: Two outcomes in a first-price auction where Advertiser Alice placed the highest bid in the auction

Figure 4: Three possible outcomes of a second-price auction. Bids placed by Advertisers A and B are the highest and second highest in the auction, respectively

45. Programmatic software that enables publishers to sell ad inventory across different advertiser tools are referred to as supply-side platforms or "SSPs." SSPs sell publisher inventory in various ways, including to ad networks, via direct deals, or through a real-time bidding auction, which is why "SSP" is occasionally used synonymously with ad exchange or ad server.

46. Google Ad Exchange (AdX) is Google's ad exchange platform and is currently marketed together with Google's ad server DFP as Google Ad Manager (GAM).[77] Publishers licensing DFP (and in a limited capacity, third-party ad servers) can have their ad inventory auctioned using AdX.[78] Google's buying tools, DV360 and Google Ads, as well as third-party buying tools that are authorized by Google, bid on ad slots in AdX.[79] Authorized third-party buying tools must be buying on behalf of multiple advertisers, meaning that an individual advertiser cannot bid into AdX.[80] To bid into AdX, third-party buyers build a real-time bidder, which is a piece of technology that can analyze all available advertisements and select one in real-time. The third-party real-time bidder connects to "Google servers to get a constant stream of 'callouts' or bid requests;"[81] the Google servers are known as "targeting servers" that are responsible for soliciting bids.[82] When an impression is auctioned in AdX, the real-time bidder is sent information about the user and the impression in the bid request, after which the real-time bidder may select an ad and a bid to send to AdX or place an empty bid if they do not choose to bid for that impression.[83]

47. As a general matter, AdX would take 20% of the clearing price as a fee for conducting the auction, though due to some publishers negotiating a lower rate and various Google programs that I will discuss in detail throughout the report, the revenue share could end up being more or less than 20% in some auctions.[84] While Google refers to the auction model that AdX operated until the fall of 2019 as second-price, the various programs implemented by Google impacted the

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[77] Bellack J., Google Ad Manager, "Introducing Google Ad Manager," (June 27, 2018) https://blog.google/products/admanager/introducing-google-ad-manager/. Accessed May 23, 2024; Conversation with Professor Chandler, June 6, 2024.
[78] Google Ad Exchange is accessible to publishers using DFP via Google Ad Manager. Publishers using third party ad servers can access DFP via a tag called the "AdX Direct" tag which is described in detail in Section V.C.
[79] Google Ads and DV360 bid through the CAT2 mixer, authorized third-party bidders bid through the RTB mixer. This list is not exhaustive, for example buyers using GMob (Admob) can also bid in AdX but are out of scope. The details of the display ads serving stack are described in Section IV.D. Google internal document, "AViD Serving Architecture (Backend)," (December 18, 2023) GOOG-AT-MDL-B-005180695 at '697 (HCI).
[80] Google, "Authorized Buyers Overview," https://support.google.com/authorizedbuyers/answer/6138000. Accessed May 30, 2024.
[81] Google, "Authorized Buyers Overview," https://support.google.com/authorizedbuyers/answer/6138000. Accessed May 30, 2024.
[82] Google internal document, "Display Ad Serving: SellSide POV," (July 2022) GOOG-AT-MDL-012693796 at '824-827 (HCI).
[83] Google, "Authorized Buyers Overview," https://support.google.com/authorizedbuyers/answer/6138000. Accessed May 30, 2024.
[84] Google internal document, "AdX dynamic sell-side revenue share (DRS v1) – project description / Mini PRD," GOOG-AT-MDL-009013303 at '303 (HCI); [redacted] Deposition, (April 19, 2024) at 214:12-19.

way that these auctions were run such that they were not true second-price auctions.[85] For this reason, I refer to the AdX auction prior to 2019 as a "modified second-price auction." After 2019, AdX switched to a first-price model, but similarly, due to a number of Google programs that modified auction dynamics, I refer to it as a modified first-price auction.[86]

C. Ad buying tools: advertisers' tools for purchasing web display advertising

48. Advertisers use ad buying tools to, among other things, manage their ad campaigns and buy ad space in real-time.[87] As discussed previously, while advertisers can negotiate direct deals with publishers to show their ads on the publisher's website, they can also bid for publisher inventory as it becomes available using an automated ad buying tool.[88] To use these tools, advertisers upload their ads to the ad buying tool, set budgets, and indicate their desired targeting criteria.[89] For example, an advertiser that sells running shoes may indicate through their buying tool that they would like to target people who are interested in running or who are in the market for sports shoes. The ad buying tool connects with networks and exchanges whose inventory matches the advertiser's targeting criteria and uses the advertiser's budget and desirability of the ad slot (based on the targeting criteria) to determine an optimal bid. The tool then submits the ad and its corresponding bid to one or more ad networks and exchanges.[90]

49. Ad buying tools can offer varying levels of sophistication when it comes to targeting and campaign management and can service advertisers of different sizes; larger and more

[85] Google internal document, "AdX First Price Auction," GOOG-TEX-00841386 at '388 (HCI); Weinberg Report, Section 7.
[86] Google internal document, "AdX First Price Auction," GOOG-TEX-00841386 at '388 (HCI); Weinberg Report, Section 6.
[87] adjust, "What is a demand-side platform (DSP)?" https://www.adjust.com/glossary/demand-side-platform/. Accessed May 23, 2024. The term DSP is often used to describe buying tools for larger advertisers, when I describe buying tools here, I refer to DSPs as well as buying tools for small advertisers, such as Google Ads.
[88] Munro B., Publift, "What is Programmatic Direct," (April 8, 2024) https://www.publift.com/blog/what-is-programmatic-direct. Accessed May 23, 2024; adjust, "What is a demand-side platform (DSP)?" https://www.adjust.com/glossary/demand-side-platform/. Accessed May 23, 2024.
[89] adjust, "What is a demand-side platform (DSP)?" https://www.adjust.com/glossary/demand-side-platform/. Accessed May 23, 2024. This describes this functionality for DSPs, buying tools for small advertisers, like Google Ads, also have this functionality. Google Ads, "How to set up your first Google Ads campaign," https://ads.google.com/intl/en_us/home/how-it-works/. Accessed May 23, 2024.
[90] Sweeney M., clearcode, "What is a Demand-Side Platform (DSP) and How Does It Work?" (January 31, 2024). https://clearcode.cc/blog/demand-side-platform/. Accessed May 23, 2024. This describes the functionality for DSPs, buying tools for small advertisers like Google Ads also have this functionality. Google Ads Help, "About the Display Network ad auction," https://support.google.com/google-ads/answer/2996564. Accessed May 21, 2024.

sophisticated advertisers generally use different, more complex tools than smaller advertisers.[91] Many ad buying tools take a percentage of each winning bid placed by the tool.[92] Some buying tools may charge a flat monthly rate or charge for advanced data insights, campaign management services, or targeting capabilities.[93]

50. Platforms used by advertisers to buy ad slots from a variety of publishers and perform real-time targeting are often referred to as demand-side platforms or "DSPs." DSPs allow advertisers to buy from multiple ad sources and manage multiple sources of demand from one interface. DSPs place bids on behalf of advertisers based on targeting criteria set by advertisers.[94] DSPs mostly function as an advertiser ad buying tool.[95]

51. Ad buying tools generally offer different ways for advertisers to pay for their ads to be shown on a publisher platform. Two common ways are paying per view (CPM) and paying per click (CPC).[96] CPM stands for "cost-per-mille," and represents the cost for every thousand impressions received. CPC, which stands for "cost-per-click," is an alternative metric in which the cost is calculated per user click on the ad.[97] Unlike CPM, CPC is calculated on an individual basis, meaning that if an advertiser has a payment plan of $1.00 CPC, they will pay $1.00 for each click on their ad, as opposed to $1.00 CPM, where they will pay $1.00 for 1000 views, regardless of clicks.[98] The primary distinction between the two metrics lies in the payment structure. With CPM, advertisers pay the full campaign price regardless of performance – in other words, an advertiser must pay if the ad receives 1,000 impressions even if no one ever clicks on the ad.

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[91] For example, DV360 is suited for enterprises while Google Ads is suited for small businesses. Google, "Take control of your campaigns," https://marketingplatform.google.com/about/display-video-360/. Accessed May 30, 2024; Google, "Drive sales with Google Ads," https://ads.google.com/home/. Accessed May 23, 2024.

[92] Greenfield I., mntn, "Demand Side Platform (DSP): What Is It and How Does It Work?" https://mountain.com/blog/demand-side-platform/. Accessed May 23, 2024. In internal Google docs, Google Ads revenue share is listed as 14 or 15% and DV360's revenue share is listed as around 10%. Google internal document, "Ecosystem – margins, auction dynamics, supply path opt...," GOOG-NE-10730420 at '425 (HCI).

[93] Greenfield I., mntn, "Demand Side Platform (DSP): What Is It and How Does It Work?" https://mountain.com/blog/demand-side-platform/. Accessed May 23, 2024.

[94] Greenfield I., mntn, "Demand Side Platform (DSP): What Is It and How Does It Work?" https://mountain.com/blog/demand-side-platform/. Accessed May 23, 2024

[95] Conversation with Professor Chandler, June 6, 2024.

[96] Criteo, "What is the difference between CPC and CPM?" (April 12, 2017) https://www.criteo.com/blog/whats-difference-cpc-cpm/. Accessed May 23, 2024.

[97] Criteo, "What is the difference between CPC and CPM?" (April 12, 2017) https://www.criteo.com/blog/whats-difference-cpc-cpm/. Accessed May 23, 2024.

[98] Criteo, "What is the difference between CPC and CPM?" (April 12, 2017) https://www.criteo.com/blog/whats-difference-cpc-cpm/. Accessed May 23, 2024.

Conversely, with CPC, advertisers are charged only for actual clicks on the ad regardless of the total number of impressions the ad received.[99]

52. AdX uses CPM to set floors within the auction, and DFP publishers are often paid on a CPM basis.[100] Furthermore, AdX requires that all bids submitted to its auctions are in CPM.[101] Thus, if a buying tool has an option for buyers to pay per click or to select another metric, the buying tool must have a conversion algorithm to convert that metric to CPM for its bid to be accepted by AdX. For example, if an advertiser is willing to pay $1.00 for each click on its ad, and historical data shows that one out of every 10 users who view the ad clicks on it, the buying tool may decide to bid $0.10 CPM for the ad to ensure that the advertiser does not lose money on average.[102]

53. Google Ads (formerly AdWords) is Google's ad buying tool for small advertisers.[103] According to Google, this tool is appropriate for advertisers without sophisticated ad campaigns, as the tool is relatively simple to set up and does not have a minimum spending or ad volume requirement to create an account.[104] Along with display ads, Google Ads also allows advertisers to set up Google Search ad campaigns, which are ads that appear alongside search results on Google.com.[105] When creating a new display advertising campaign, Google Ads users indicate two key pieces of information: their targeting criteria and the campaign budget type.[106] For example, an advertiser may choose to target people who are "fans of sports and travel" and set up a manual

[99] Criteo, "What is the difference between CPC and CPM?" (April 12, 2017) https://www.criteo.com/blog/whats-difference-cpc-cpm/. Accessed May 23, 2024.
[100] Unified pricing rule floors are set on a CPM basis, Google Ad Manager, "Unified First-Price Auction – Best practices," https://services.google.com/fh/files/misc/unified_first-price_auction_best_practices.pdf. Accessed May 23, 2024. RTB buyers must place bids in CPM. Google, "Introduction to real-time bidding (RTB)," https://support.google.com/authorizedbuyers/answer/6136272. Accessed May 23, 2024.
[101] Metrics used for programmatic guaranteed and preferred deals can include CPD (cost-per-day), CPF (campaign total cost), or CPM. Google Ad Manager Help, "Programmatic Guaranteed vs. Preferred Deals," https://support.google.com/admanager/answer/7637485. Accessed May 23, 2024.
[102] This is a simplified version of conversions that ignores the publisher's revenue share and other factors that may be considered by conversation models. [redacted] Deposition, (April 19, 2024) at 125:15-23.
[103] Google Ads is often referred to in internal documents as "AdWords" or "Google Display Network" (GDN). Some documents refer to GDN as AdSense and Google Ads together, while others refer GDN as just Google Ads. [redacted] Deposition, (April 19, 2024) at 23:16-17; Google internal document, "Google Display Network Launch," GOOG-TEX-00820709 at '710 and '714 (HCI).
[104] Google, "3 questions businesses should ask when they get started with Google Ads," https://blog.google/outreach-initiatives/small-business/small-business-google-ads-tips/. Accessed May 23, 2024.
[105] Google Ads, "Be just a Google Search away," https://ads.google.com/intl/en_us/home/campaigns/search-ads/. Accessed May 23, 2024.
[106] Google Ads, "How to set up your first Google Ads campaign," https://ads.google.com/intl/en_us/home/how-it-works/. Accessed May 23, 2024.

CPC budget type and indicate they are willing to pay a maximum of $1.00 per click on their ad. Advertisers can also use Google Ads automated bidding budget campaign.[107] For example, in a "maximize clicks" automated bidding budget type, advertisers set an average daily budget and Google Ads tries to get as many clicks as possible within that budget.[108] Advertisers can optionally set a bid maximum for individual bids to have a little more control.[109] The advertiser's budget and budget type are used by the buying tools' bidding algorithms to determine when and how much to bid.[110]

54. Google Ads provides ads for AdSense publishers, places bids into AdX, and submits bids to third-party exchanges in a limited capacity through a program called AWBid, which is described in detail in Section IV.GError! Unknown switch argument..[111] Google Ads takes a [redacted]%[112] revenue share from each winning bid it places in AdX.[113] Google Ads is also used by advertisers to create Search ads on Google.com.[114]

55. DV360 is Google's ad buying tool for larger and enterprise-size advertisers (*e.g.*, the minimum monthly spend on DV360 is reported to be around $50,000).[115] DV360 offers more

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[107] Google Ads Help, "About bidding features in Display campaigns," https://support.google.com/google-ads/answer/2947304. Accessed May 23, 2024.
[108] Google Ads Help, "Maximize clicks: Definition," https://support.google.com/google-ads/answer/6336101. Accessed May 23, 2024.
[109] Google Ads Help, "Maximum CPC bid: Definition," https://support.google.com/google-ads/answer/6326. Accessed May 23, 2024.
[110] Google Ads Help, "Maximum clicks: Definition," https://support.google.com/google-ads/answer/6336101?hl=en. Accessed June 5, 2024
[111] Google internal document, "Ecosystem – margins, auction dynamics, supply path opt...," GOOG-NE-10730420 at '427 (HCI); Google internal document, "AWBid Overview," GOOG-DOJ-14298902 at '903 (HCI); [redacted] Deposition, (April 26, 2024) at 101:14-18.
[112] Some internal Google documents say [redacted] and some say [redacted] so this may have changed over time.
[113] Google internal document, "Ecosystem – margins, auction dynamics, supply path opt...," GOOG-NE-10730420 at '425 (HCI).
[114] Google Ads Help, "Create a Search campaign," https://support.google.com/google-ads/answer/9510373. Accessed May 23, 2024; Search ads are not within the scope of this report.
[115] Programmads, "Why use DV360 instead of Google Ads?" https://programmads.com/project/why-use-display-video-360-instead-of-google-ads/. Accessed May 23, 2024; Google does not publicly disclose pricing for DV360, but several online sources list $50,000 as the minimum monthly spend. Ganz E., ADCORE Blog, "What is DV360 and How to Start Advertising," (March 11, 2024) https://www.adcore.com/blog/what-is-dv360-and-how-to-start-advertising. Accessed May 23, 2024. The Google Marketing Platform page places DV360 under the "enterprise" tab. Google Marketing Platform, "Take control of your campaigns," https://marketingplatform.google.com/about/display-video-360/ Accessed May 23, 2024; DV360 used to be called "DoubleClick Bid Manager" (DBM) and is sometimes referred to internally at Google as "XBid". Internal documents often refer to DV360 using these terms. Display & Video 360 Help, "Introducing Google Marketing Platform," https://support.google.com/displayvideo/answer/9015629. Accessed June 4, 2024; [redacted] Deposition, (April 19, 2024) at 118:11-13.

advanced capabilities than Google Ads in targeting, ad placement, and reporting.[116] It offers all the targeting options available on Google Ads, along with advanced options that allow for more precise user targeting.[117] It bids into AdX and into third-party exchanges, therefore offering a broader range of ad inventory.[118, 119, 120] Additionally, DV360 has more advanced analytic capabilities and offers reporting options beyond the basic campaign analytics offered by Google Ads.[121] DV360 has more media formats, such as audio and native advertisements, and has the option for advertisers to set up direct deals with publishers along with the option of bidding in exchanges.[122] Overall, DV360 is designed for handling larger and more sophisticated advertising campaigns than Google Ads.

56. DV360 initially only offered CPM payment campaigns until Google introduced DV360 Pay-Per-Outcome (PPO) in September 2019, which gave DV360 advertisers the option to pay for outcomes, such as clicks or other metrics, similar to how payment works in Google Ads.[123] DV360 PPO is described in greater detail in Section IV.I.

IV. OVERVIEW OF HOW INFORMATION IS PASSED FROM ONE TOOL TO ANOTHER

57. This section discusses how information is passed from one ad stack tool to another. First, I provide an overview of the ad serving stack and information flow during the ad serving process, including descriptions of line items, ad tags, user data flows, and mixers. Then, I describe programs that enable Google's ad buying tools to bid into third-party exchanges, purchase directly

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116 Programmads, "Why use DV360 instead of Google Ads?" https://programmads.com/project/why-use-display-video-360-instead-of-google-ads/. Accessed May 23, 2024.
117 Jain A., Tatvic, "What is the Difference between DV360 and Google Ads?" https://www.tatvic.com/blog/what-is-the-difference-between-dv360-and-google-ads/. Accessed May 23, 2024.
118 Google, "Introducing Google Marketing Platform – Display & Video 360 Help," https://support.google.com/displayvideo/answer/9015629?hl=en. Accessed June 4, 2024.
119 Display & Video 360 Help, "Managing exchanges," https://support.google.com/displayvideo/answer/9230278?hl=en. Accessed June 6, 2024.
120 Display & Video 360 Help, "Supported display exchanges," https://support.google.com/displayvideo/table/3267029?hl=en. Accessed June 6, 2024.
121 Jain A., Tatvic, "What is the Difference between DV360 and Google Ads?" https://www.tatvic.com/blog/what-is-the-difference-between-dv360-and-google-ads/. Accessed May 23, 2024.
122 Native ads are ads that feel as though they are part of the page content, based on their style. Adjust, "What is native advertising," https://www.adjust.com/glossary/native-advertising/. Accessed May 23, 2024; Medium, "Google Ads vs. DV360: Which One is Better?" (March 20, 2024) https://medium.com/@contact_10971/google-ads-vs-dv360-which-one-is-better-8fbd3a883787. Accessed May 23, 2024.
123 Google internal document, "Pay per Outcome in DBM," (February 10, 2018) GOOG-NE-13620081 at '081-083 (HCI).

from publishers, and purchase ads based on outcomes as opposed to views. Lastly, I describe how Google's ad serving functionality has changed over time and how it functions today.

A. Line items are set in GAM and contain information that defines available advertisements for a publisher's website

58. "Line items" are information fields set in DFP that contain ad information from direct deals with advertisers or ads received from an ad exchange or network.[124] Line items define how and where ads are intended for display on a website or application. For example, each line item from a direct deal contains details such as the number of times the advertiser wants an advertisement to be shown, negotiated cost for the campaign, campaign period, etc.[125] Each line item can only belong to one "order," which is a transaction between the publisher and a buyer.[126] There are different types of line items with varying levels of priority, which are represented by numeric values and help determine how line items compete against each other for an impression. A lower number assigned to a line item reflects its higher priority.[127]

59. Google groups line items into two categories: "guaranteed" (also known as "reservation")[128] and "non-guaranteed" (also known as "remnant")[129] line items. Guaranteed line items are contractually obligated to deliver a set number of impressions, while non-guaranteed line items are typically used to fill a site's unsold inventory. In other words, when a website does not have enough guaranteed line items to satisfy all available impressions, the remaining (remnant) inventory can be filled using non-guaranteed line items. Guaranteed line items have a higher priority and are therefore prioritized over non-guaranteed line items.

60. There are only two types of guaranteed line items: "Sponsorship" and "Standard." There are seven types of non-guaranteed line items: AdSense (or Ad Network); AdX (or Ad Exchange); Preferred Deals; Network; Bulk; Price Priority; and House. In addition to being booked directly by the publisher through the GAM interface, non-guaranteed line items can also represent third-

[124] Google Ad Manager Help, "About line items," https://support.google.com/admanager/answer/9405477. Accessed May 23, 2024.
[125] Google Ad Manager Help, "About line items," https://support.google.com/admanager/answer/9405477. Accessed May 23, 2024.
[126] Google Ad Manager Help, "Add new line items," https://support.google.com/admanager/answer/82236. Accessed May 23, 2024; Google Ad Manager Help, "Get started with ads in Google Ad Manager," https://support.google.com/admanager/answer/6027116. Accessed May 23, 2024.
[127] Google Ad Manager Help, "Line item types and priorities," https://support.google.com/admanager/answer/177279. Accessed May 23, 2024.
[128] Google internal document, "Life of a Bid Request," GOOG-AT-MDL-004221745 at '763 (HCI).
[129] Google internal document, "Life of a Bid Request," GOOG-AT-MDL-004221745 at '763 (HCI).

party ad networks or exchanges.[130] More specifically, third-party ad exchanges can be represented as Price Priority line items, while third-party ad networks can be represented as either Price Priority or Network line items.[131] Therefore, when I discuss remnant line items or non-guaranteed line items throughout this report, I am also referring to line items corresponding to demand from third-party networks and exchanges. Table 1 below provides a detailed look at each of the line items of both guaranteed and non-guaranteed types.

Table 1: Types of Google Ad Manager Line Items

Line Item Category	Line Item Type	Priority	Description
Guaranteed	Sponsorship	4	Sponsorship line items have the highest priority and are served based on a defined percentage of impressions and a given campaign period. This line item type is typically used when a buyer wants to "take over" a webpage.[132]
	Standard	6 8 10	Standard line items are served based on a defined impression goal and campaign period.[133]
Non-guaranteed	AdSense	12	AdSense line items are targeted to specific inventory available to AdSense buyers.[134]
	AdX	12	AdX line items are targeted to specific inventory available to buyers bidding into AdX.[135]

130 Google internal document, "RTB Insights," GOOG-AT-MDL-001793318 at '363-364 (HCI).
131 Google internal document, "RTB Insights," GOOG-AT-MDL-001793318 at '363-364 (HCI). Occasionally, third-party exchanges and/or networks can be represented as Sponsorship or Standard line items. For example, Header Bidding buyers, who are third-party exchanges and/or networks that participate in an auction outside of AdX, can occasionally be represented in this way. Google internal document, "Header Bidding & AdX Positioning," (December 2, 2015) GOOG-AT-MDL-004284449 at '461 (CI).
132 Google Ad Manager Help, "Line item types and priorities," https://support.google.com/admanager/answer/177279 Accessed May 23, 2024.
133 Google Ad Manager Help, "Line item types and priorities," https://support.google.com/admanager/answer/177279. Accessed May 23, 2024.
134 Google Ad Manager Help, "Line item types and priorities," https://support.google.com/admanager/answer/177279. Accessed May 23, 2024.
135 Google Ad Manager Help, "Line item types and priorities," https://support.google.com/admanager/answer/177279. Accessed May 23, 2024.

Line Item Category	Line Item Type	Priority	Description
	Preferred Deals	A "fixed value" that only loses to guaranteed line items.[136]	Preferred Deals give certain buyers priority tier inventory or can help sell unique inventory. Preferred Deal line items generally serve ahead of all line items except guaranteed line items.[137]
	Network	12	Network line items can be used to fulfill a defined percentage of remaining impressions not fulfilled by guaranteed line items.[138]
	Bulk	12	Bulk line items can be used to fill unsold inventory within a defined impression cap.[139]
	Price Priority	12	Price Priority line items can be used to fill unsold inventory with the highest paying line item available.[140]
	House	16	House line items are ads that promote products or services chosen by the publisher.[141] They typically do not generate any revenue,[142] and hence are only served when no remnant line items (Network, Bulk, Price Priority), AdX or Open Bidding

[136] Google Ad Manager Help, "Line item types and priorities," https://support.google.com/admanager/answer/177279. Accessed May 23, 2024.
[137] Google Ad Manager Help, "Line item types and priorities," https://support.google.com/admanager/answer/177279. Accessed May 23, 2024.
[138] Google Ad Manager Help, "Network line items," https://support.google.com/admanager/answer/171909. Accessed May 23, 2024; Google Ad Manager Help, "Line item types and priorities," https://support.google.com/admanager/answer/177279. Accessed May 23, 2024.
[139] Google Ad Manager Help, "Line item types and priorities," https://support.google.com/admanager/answer/177279. Accessed May 23, 2024.
[140] Google Ad Manager Help, "Line item types and priorities," https://support.google.com/admanager/answer/177279. Accessed May 23, 2024.
[141] Google Ad Manager Help, "House line items," https://support.google.com/admanager/answer/79305. Accessed May 23, 2024.
[142] Google Ad Manager Help, "House line items," https://support.google.com/admanager/answer/79305. Accessed May 23, 2024.

Line Item Category	Line Item Type	Priority	Description
			(formerly known as Exchange Bidding) demand are available to serve.[143]

61. Figure 5 below shows an example set of line items for a hypothetical publisher called "PubNews."[144]

Figure 5: Example line items for a hypothetical publisher, PubNews[145]

Line Item Number	Type	Priority	Target	Start/End Date	Delivery Rate	Rate	Ad Unit	Targeting
LI 1	Sponsor	4	50 %	1/1 - 1/7	Evenly	$ 5.00 CPM	PubNews/Sports	"Gender" is "F"
LI 2	Standard	8	700,000 impressions	1/1- 1/7	Frontloaded	$ 7.00 CPM	PubNews/Sports PubNews/Gossip	
LI 3	AdX	12	-	1/1 - 12/31	-	-	PubNews/Sports PubNews/Gossip	
LI 4	Bulk	12	100,000 impressions	1/1 - 2/28	-	$ 12.00 CPM	PubNews/Gossip	"Gender" is "M"
LI 5	Price Priority	12	-	1/1 – 12/31	-	$10.00 CPM	PubNews/Gossip	"Gender" is "F"

62. In this example, PubNews is an online magazine with "Sports" and "Gossip" sections that each have one ad slot. Line item 1 is a Sponsorship line item, which indicates that PubNews has entered a deal with an advertiser to show the advertiser's ads for 50% of impressions on the "Sports" page. This ad is targeted at female users, and the deal is valid between January 1 and 7. Line item 2 is a Standard line item and represents a pre-negotiated deal to show 700,000 impressions of the advertiser's ad on either section of the PubNews page. The delivery rate is "frontloaded," meaning that more advertisements should be shown at the beginning of the negotiated period, January 1 through January 7. Line item 3 is an AdX line item and will run an auction in AdX. Line item 4 is a Bulk line item, which means that PubNews will fill up to 100,000 impressions with the advertiser's ad, but these are not guaranteed. Finally, line item 5 is a Price Priority type targeting female users. Line items 1, 2, 4, and 5 are negotiated directly between the publisher and the advertiser and entered into GAM. Their CPMs are therefore fixed. Line item 3

[143] Google Ad Manager Help, "Line item types and priorities," https://support.google.com/admanager/answer/177279. Accessed May 23, 2024; Open bidding, also known as "Exchange Bidding," is described in Section IX.
[144] Based on Google internal document, "Ad Manager Ecosystem 101," GOOG-AT-MDL-001004706 at '722 (HCI).
[145] This example has been synthesized from an internal Google document. Google internal document, "Ad Manager Ecosystem 101," GOOG-AT-MDL-001004706 at '722 (HCI).

contains the winning bid from the AdX auction, which runs in real-time as the user loads a webpage.

63. In this example, different line items may be selected as the winning ad for a particular ad slot on a page depending on a variety of factors.[146] This example intends to convey an overview of how line item selection works with Enhanced Dynamic Allocation, which is discussed in detail in Section VII. Consider a scenario where a female user, as indicated by targeting data, opened the webpage PubNews "Sports" on January 6.

1) If PubNews is behind schedule on delivering its promised 50% for line item 1, DFP will likely choose to show the ad associated with this line item because the negotiated period has almost concluded.

2) If PubNews is on track to meet the target in line items 1 and 2, one of the remnant line items may be shown to the user. In this example, line items 3, 4, and 5 all have the same priority level. However, line items 4 and 5 are for a different unit, the "Gossip" section, and line item 4 targets male users. Therefore, of the remnant line items, only line item 3 is eligible to serve. If the AdX auction returns an ad with a $10.00 CPM bid, which is higher than the floor, then that ad will be shown.

64. However, if a female user opens the "Gossip" section on January 10, all guaranteed line items have expired, and line item 4 is ineligible because of targeting. If AdX returns a bid of $6.00, it is beaten by line item 5 with a $10.00 CPM, and the ad from line item 5 will serve.

65. As another example, if a male user opens the "Gossip" section, line item 1 is ineligible based on targeting, and the ad for line item 2 may be shown to the user, depending on the delivery schedule. If line item 2 is on track to deliver, DFP may choose to serve a remnant line item. Line items 3 and 4 are eligible based on targeting. If the AdX auction returns a bid with a CPM of $8.00, line item 4 will be selected since it has a higher CPM.

66. Other auction outcomes are possible depending on user targeting and date, delivery schedules of guaranteed line items, and the bid value returned by the AdX auction.

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[146] For purposes of illustration, this example abstracts away auction mechanics such as EDA or unified floors and focusing on the overall goal of line item selection.

B. Ad tags are used by publisher websites to communicate with the publisher's ad server

67. The process of serving an advertisement begins with an "ad tag" on a publisher's website. An ad tag is a piece of code that is embedded on a publisher's website and allows the website to communicate with an ad server.[147] The ad tag runs when a user opens the website on a browser. The most common way publishers create ad tags is by registering their website on an ad server, which in turn generates an ad tag for the publisher to place on their website.[148] The ad tag handles the beginning and the end of the ad serving process by sending out a request for ads to the ad server, receiving the response, and sending the winning advertisement to the browser.[149]

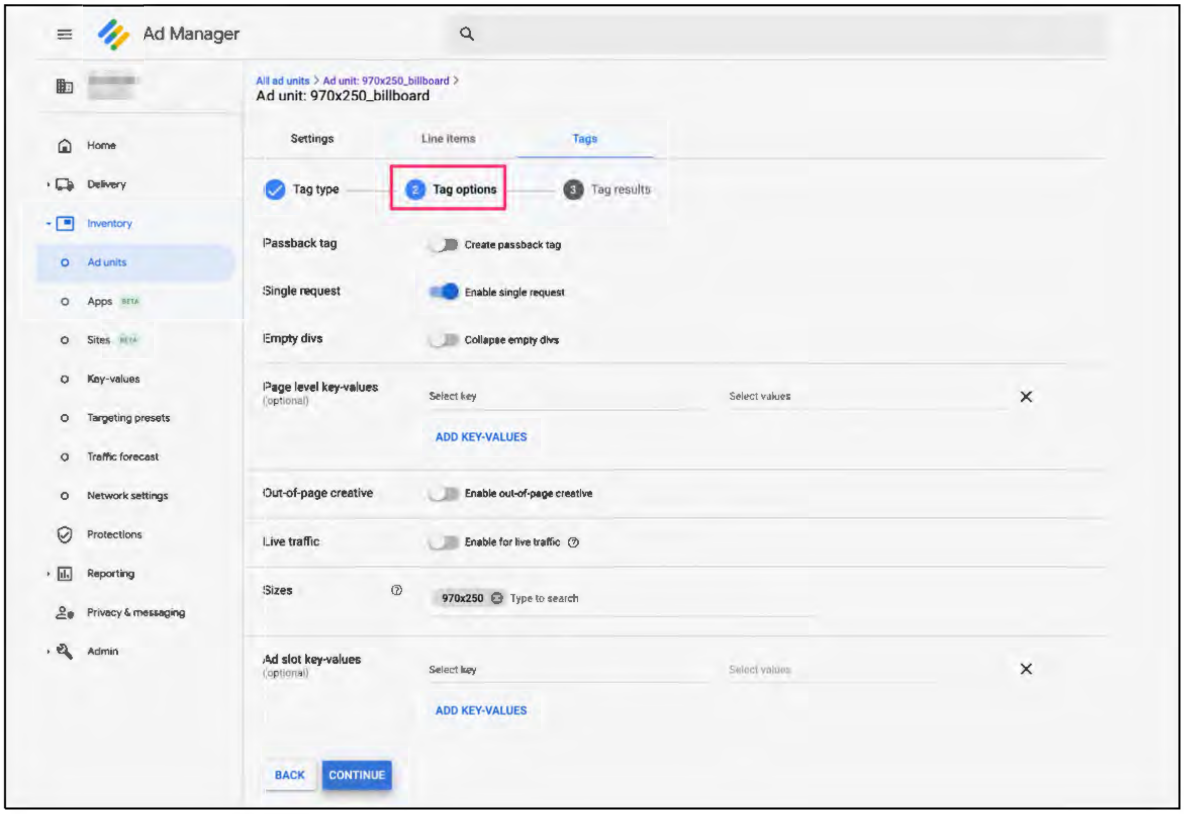
68. Tags that are used to call the DFP ad server are currently part of the Google Publisher Tag or "GPT" ad tag library.[150] GPT tags are written in the JavaScript programming language and perform three general tasks: (1) allow publishers to create ad slots, (2) send an ad request to DFP, and (3) receive and process DFP's response to render an ad on the page.[151] GPT tags were introduced in October 2011 to replace DoubleClick DFP tags.[152] GPT tags came with a number of additional features, such as asynchronous tags, which allows the ad to load independently of the rest of the publisher's content (*i.e.*, if an ad fails to load, it will not slow down the loading process of the entire webpage) and single request architecture (SRA), which allows sending all ad slots available on a page in a single request to DFP.[153]

69. When publishers generate a GPT tag, they can include several specifications for their ad slot that determine how the ad renders and how the DFP request is sent. Figure 6 shows the interface that a publisher sees and the options that are available when setting up a GPT tag.[154] For

[147] Novatska K., Cepom, "What is an Ad Tag and How to Generate It," (March 11, 2020) https://epom.com/blog/ad-server/what-is-an-ad-tag. Accessed May 23, 2024.
[148] Novatska K., Cepom, "What is an Ad Tag and How to Generate It," (March 11, 2020) https://epom.com/blog/ad-server/what-is-an-ad-tag. Accessed May 23, 2024.
[149] Novatska K., Cepom, "What is an Ad Tag and How to Generate It," (March 11, 2020) https://epom.com/blog/ad-server/what-is-an-ad-tag. Accessed May 23, 2024.
[150] Google, "Get Started with Google Publisher Tag," https://developers.google.com/publisher-tag/guides/get-started. Accessed May 23, 2024.
[151] Google internal document, "Google Publisher Tag," GOOG-AT-MDL-B-005090414 at '414 (HCI).
[152] Google, "Introducing the next generation of the DFP ad tag," (October 25, 2011) https://doubleclick-publishers.googleblog.com/2011/10/introducing-next-generation-of-dfp-ad.html. Accessed June 4, 2024.
[153] Google Ad Manager Help, "Overview of Google Publisher Tag," https://support.google.com/admanager/answer/181073. Accessed May 30, 2024.
[154] Google Ad Manager Help, "Generate ad tags," https://support.google.com/admanager/answer/177207. Accessed May 23, 2024.

example, publishers can indicate the ad sizes that the slot can accept and whether the ad slot should "collapse" if an ad is not served.[155]

<u>Figure 6: The user interface for configuring a GPT tag[156]</u>



70. Google also provides AdX tags, which allow publishers to send ad requests directly to the AdX auction without calling DFP.[157] Using AdX tags, publishers with non-Google ad servers can auction their slots in AdX.[158] AdX tags are sometimes referred to as "adsbygoogle" tags, which also service AdSense traffic.[159]

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[155] Google Ad Manager Help, "Generate ad tags," https://support.google.com/admanager/answer/177207. Accessed May 23, 2024.
[156] Zaiceva A., "Google Publisher Tag (GPT): A Complete Beginner's Guide," (July 2, 2021) https://setupad.com/blog/google-gpt/. Accessed May 23, 2024.
[157] Google internal document, "AdX Direct Review," (February 11, 2020) GOOG-DOJ-27799214 at '215 (CI).
[158] Google internal document, "AdX Direct Review," (February 11, 2020) GOOG-DOJ-27799214 at '215 (CI).
[159] Google internal document, "Vision for Tagging Infrastructure," (June 16, 2014) GOOG-TEX-00260934 at '945 (HCI).

C. Google retrieves user information from cookies and publisher-provided data, and uses it to identify users and target ads

71. A user is identified to the publisher's ad server through an ID, which can come from a variety of sources including cookies, as well as publisher-provided information.[160] Cookies are text files with pieces of data about a user and can be used to store user information, personalize the user's experience, and track user data over time.[161] As one example, cookies can be used to remember the username and password of a user for a website, eliminating the need for users to remember login information. They can also be used to collect information about a user and personalize their experience, such as providing ads based on previously viewed products.[162] First-party cookies are created by the website owner (*i.e.*, the publisher) and stored directly on the website visited by the user. For example, first-party cookies are used if a website stores login information for users on that website. Third-party cookies are cookies from a different domain than the one visited by a user.[163] They are often used by ad servers to track user behavior across several websites. For example, if a user browses new sneakers on Amazon, they may get an ad for sneakers on a different website because of third-party cookies.[164] Many popular browsers have already taken steps to limit or remove third-party cookies.[165,166] Google Chrome, the browser developed by Google, has announced plans to phase out third-party cookies, with the aim of completely removing them for all users by early 2025.[167] I understand that while publishers will have access to some of the data that Google collects, publishers do not have access to all of the

160 Google internal document, "DRX Identity 101," (March 2018) GOOG-AT-MDL-001963813 at '816 (HCI).
161 Kaspersky, "What are Cookies?" https://usa.kaspersky.com/resource-center/definitions/cookies. Accessed May 23, 2024.
162 Kaspersky, "What are Cookies?" https://usa.kaspersky.com/resource-center/definitions/cookies. Accessed May 23, 2024.
163 Kaspersky, "What are Cookies?" https://usa.kaspersky.com/resource-center/definitions/cookies. Accessed May 23, 2024.
164 Kaspersky, "What are Cookies?" https://usa.kaspersky.com/resource-center/definitions/cookies. Accessed May 23, 2024.
165 Mills, C., Mozilla, "Saying goodbye to third-party cookies in 2024," (December 7, 2023) https://developer.mozilla.org/en-US/blog/goodbye-third-party-cookies/. Accessed May 24, 2024.
166 Microsoft Edge Team, Microsoft Edge Blog, "New Privacy-Preserving Ads API coming to Microsoft Edge" (March 5, 2024) https://blogs.windows.com/msedgedev/2024/03/05/new-privacy-preserving-ads-api/. Accessed June 6, 2024.
167 Google internal document, "Google Ad Manager Audience 101," (July 13, 2020) GOOG-AT-MDL-002011973 at '982 (HCI); Privacy Sandbox, "Prepare for third-party cookie restrictions," https://developers.google.com/privacy-sandbox/3pcd. Accessed May 21, 2024.

data that Google collects.[168] In particular, prior to Google's migration to a modified first-price auction, buyers were capable of opting out of Google disseminating their data.[169]

72. Google's third-party cookies provide two types of user IDs: [redacted].[170] In the absence of third-party cookies, Google can use [redacted] or [redacted] to identify users. [redacted] are cookies placed by Google on a publisher's website that function similarly to first-party cookies in the sense that they are not used to track a user across websites.[171] [redacted] are limited in their capabilities and cannot be used for ad personalization.[172] [redacted].[173] Google's stated order of preference for user identification is [redacted].[174]

73. [redacted].[175] However, in 2016 in a project internally called Narnia 2.0, Google introduced the ability for users to opt into ad personalization based on their [redacted].[176] For users that do opt-in, [redacted].[177]

[168] [redacted] Deposition, (April 19, 2024) at 33:14-35:18.
[169] [redacted] Deposition, (April 19, 2024) at 35:2-18.
[170] Google internal document, "DRX Identity 101," (March 2018) GOOG-AT-MDL-001963813 at '816-817 (HCI); Google internal document, "Narnia 2 Gaia Keyed Serving End State Design (Tinman)," (June 12, 2017) GOOG-AT-MDL-016354429 at '429, '438. (CI); [redacted] Deposition, (May 23, 2024) at 220:8-222:9.
[171] Google refers to GFP cookies as first-party cookies, see Google internal document, "DRX Identity 101," (March 2018) GOOG-AT-MDL-001963813 at '816 (HCI). However, since they are placed by Google and not the publisher, they are not strictly first-party, but function similarly in the sense that they are not used to identify a user across different websites.
[172] Google internal document, "Project Samoas: Publisher's 1P Cookies/Ids Strategy," (January 2020) GOOG-AT-MDL-001418931 at '943 (HCI).
[173] Google internal document, "Project Samoas: Publisher's 1P Cookies/Ids Strategy," (January 2020) GOOG-AT-MDL-001418931 at '943 (HCI).
[174] Google internal document, "GAM and AdSense Monitoring for User IDs," (May 21, 2020) GOOG-AT-MDL-001418741 at '743 (HCI).
[175] Google internal document, [redacted] (June 12, 2017) GOOG-AT-MDL-016354429 at '430, '438. (CI).
[176] Google internal document, [redacted] (June 12, 2017) GOOG-AT-MDL-016354429 at '429, '436. (CI).
[177] Google internal document, "Detailed Design for Narnia2 AFC Serving Stack," GOOG-AT-MDL-007275806 at '810 (HCI).

74. Figure 7 is from an internal Google document and shows the targeting capabilities of Google Ads and DV360 before and after [redacted]

Figure 7: Additional capabilities provided by [redacted].

[redacted]

75. [redacted]

178 Google internal document, "Narnia2 Overview 2016-12-14," (December 14, 2016) GOOG-AT-MDL-007418936 at '978 (HCI).

179 Google internal document, "Narnia2 Overview 2016-12-14," (December 14, 2016) GOOG-AT-MDL-007418936 at '978 (HCI).

180 Google internal document, [redacted] (June 12, 2017) GOOG-AT-MDL-016354429 at '440. (CI); [redacted] Deposition, (May 23, 2024) at 220:8-222:9.

[redacted]

76. [redacted]

77. PPID stands for "publisher provided identifiers" and is an option publishers can opt into within GAM to channel their first-party user data into Google's programmatic demand. PPIDs are user IDs collected by publishers and are intended to be meaningless to Google outside of uniquely identifying a user, which means that any information the publisher has about a user based on their ID is not communicated to Google with the PPID.[184] Google states that PPIDs passed to DFP should be encrypted and publishers must offer users the option to opt out of ad personalization, in which case the publisher should stop sending the PPID in the ad request. Google encourages publishers to adopt PPID as browsers, including Chrome, phase out third-party cookies.[185]

78. Google's data storage server, [redacted]

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181 Google internal document, [redacted] (June 12, 2017) GOOG-AT-MDL-016354429 at '440. (CI).
182 Google internal document, "Narnia2 Overview 2016-12-14," (December 14, 2016) GOOG-AT-MDL-007418936 at '978 (HCI).
183 Google internal document, "Project Samoas: Publisher's 1P Cookies/Ids Strategy," (January 2020) GOOG-AT-MDL-001418931 at ''934, '943 (HCI).
184 Google Ad Manager Help, "About publisher provided identifiers," https://support.google.com/admanager/answer/2880055. Accessed May 23, 2024.
185 Google Ad Manager Help, "About publisher provided identifiers," https://support.google.com/admanager/answer/2880055. Accessed May 23, 2024.
186 Google internal document, "Detailed Design for Narnia2 AFC Serving Stack," GOOG-AT-MDL-007275806 at '807 (HCI).
187 Google internal document, "Detailed Design for Narnia2 AFC Serving Stack," GOOG-AT-MDL-007275806 at '807 (HCI).
188 Google internal document, "Detailed Design for Narnia2 AFC Serving Stack," GOOG-AT-MDL-007275806 at '807 (HCI).

[redacted]

D. Overview of the ad serving stack

79. As I previously described in Section IV.B, when a user visits a website with a GPT tag, the GPT tag composes an ad request for the publisher's ad server. The ad request contains information about the publisher, the ad slot, and the user.[192] An ad request may contain many parameters that can convey information about the publisher.[193] These parameters contain various pieces of information including: (1) inventory unit (for example, which section of an online newspaper the ad slot is in), (2) the ad slot information, such as its size and the format of the ad, (3) consent signals, which are mostly user privacy consent signals, (4) identity signals, such as user cookie IDs, (5) targeting information, for example the publisher indicating that this user is a regular viewer of the sport section of their newspaper, (6) spam signals, which are used to decide if the ad

189 [redacted] oogle internal document, [redacted] (March 1, 2015) GOOG-AT-MDL-B-003983972 at '972-973 (CI); Google internal document, "ICM Narnia 2.0 Overview," (September 1, 2016) GOOG-DOJ-AT-02309120 at '121-122 (HCI); Google internal document, "Detailed Design for Narnia2 AFC Serving Stack," GOOG-AT-MDL-007275806 at '807 (HCI).

190 Search Ads 360 Help, "Set up remarketing lists for search ads," https://support.google.com/searchads/answer/7196986?hl=en. Accessed June 7, 2024; Google for Developers, "Cookie Matching | Real-time Bidding," https://developers.google.com/authorized-buyers/rtb/cookie-guide. Accessed June 7, 2024.

191 Google internal document, "Detailed Design for Narnia2 AFC Serving Stack," GOOG-AT-MDL-007275806 at '807 (HCI).

192 Google internal document, "Publisher request and response," (2017) GOOG-AT-MDL-001409774 at '795 (CI).

193 Google internal document, "Publisher request and response," 2017) GOOG-AT-MDL-001409774 at '785 (CI).

request represents a real user, and (7) experiment information, which informs DFP if the impression is part of an experiment on a portion of traffic run by Google.[194]

80. Figure 8 shows an example of the beginning of an ad request URL sent from the user's browser to DFP. The ad request URL begins with "https://googleads.g.doubleclick.net/pagead/ads?" which indicates the domain from which GPT is loaded, followed by key-value pairs that communicate information to DFP. For example, "gdfp_req=1" is a standard value sent to indicate that this is an ad request from a GPT tag; "cookie = 7fh..." contains the user's GFP cookie ID; and "url=https://someurl.com" indicates the page URL.[195]

Figure 8: An example of an ad request URL sent from the user''s browser to DFP[196]

```
https://googleads.g.doubleclick.net/pagead/ads?gdfp_req=1&pvsid
=4530677874157224&impl=fifs&cookie=7fhdnekg9sh...1u2i39rhfna
&u_tz=-240&ecs=20200911&url=https://someurl.com&...
```

81. [redacted]

[194] [redacted] Deposition, (April 19, 2024) at 82:2-87:23; Google internal document, "Publisher request and response," 2017) GOOG-AT-MDL-001409774 at '785 (CI); Google internal document, "Display Ad Serving: SellSide POV," (July 2022) GOOG-AT-MDL-012693796 at '813 (HCI).

[195] Google internal document, "Sample Value for Ad Request," GOOG-AT-MDL-B-007919337 at '337-339 (HCI); Google internal document, "Publisher request and response," (2017) GOOG-AT-MDL-001409774 at '785 (CI).

[196] Sample ad request URL based on Google internal document, "Sample Value for Ad Request," GOOG-AT-MDL-B-007919337 at '337-339 (HCI); Google internal document, "Publisher request and response," (2017) GOOG-AT-MDL-001409774 at '785 (CI).

[197] Google internal document, "AViD Serving Architecture 101 (Backend)," (December 18, 2023) GOOG-AT-MDL-B-005180695 at '697 (HCI); [redacted] Deposition, (April 19, 2024) at 79:10-24.

[198] Google internal document, "AViD Serving Architecture 101 (Backend)," (December 18, 2023) GOOG-AT-MDL-B-005180695 at '696 (HCI); [redacted] Deposition, (April 19, 2024) at 88:5-15; [redacted] Deposition, (April 19, 2024) at 90:14-16; [redacted] Deposition, (April 19, 2024) at 91:4-93:5.

[199] Google internal document, "AViD Serving Architecture 101 (Backend)," (December 18, 2023) GOOG-AT-MDL-B-005180695 at '695-697 (HCI); [redacted] Deposition, (April 19, 2024) at 90:17-91:3.

[redacted]

82. [redacted]

83. [redacted]

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200 Google internal document, "AViD Serving Architecture 101 (Backend)," (December 18, 2023) GOOG-AT-MDL-B-005180695 at '697 (HCI).
201 Google internal document, "AViD Serving Architecture 101 (Backend)," (December 18, 2023) GOOG-AT-MDL-B-005180695 at '697 (HCI); [redacted] Deposition, (April 19, 2024) at 91:25-92:9; [redacted] Deposition, (April 19, 2024) at 95:13-102:11; [redacted] Deposition, (April 19, 2024) at 117:9-12.
202 Google internal document, "AViD Serving Architecture 101 (Backend)," (December 18, 2023) GOOG-AT-MDL-B-005180695 at '696 (HCI).
203 Google internal document, "AViD Serving Architecture 101 (Backend)," (December 18, 2023) GOOG-AT-MDL-B-005180695 at '696 (HCI).
204 Logs are "checkpoints" in code that record information specific by the developer. They are used to track what is happening in the codebase and locate sources of errors. Google internal document, "Life of a query & Auction Overview," GOOG-AT-MDL-002295716 at '726 (HCI); Google internal document, "Detailed Design for Narnia2 AFC Serving Stack," GOOG-AT-MDL-019603579 at '582 (HCI).
205 Google internal document, "Display Ads: Unified Identity Service (UIS)," GOOG-AT-MDL-007400353 at '359 (HCI).
206 Encryption is a way of encoding data so that unauthorized parties can't read it. Authorized parties have a decryption key that allows them to unencrypt the data. Google internal document, "Display Ads: Unified Identity Service (UIS)," GOOG-AT-MDL-007400353 at '366 (HCI).
207 Google internal document, "Display Ads: Unified Identity Service (UIS)," GOOG-AT-MDL-007400353 at '366 (HCI).
208 Google internal document, "Display Ads: Unified Identity Service (UIS)," GOOG-AT-MDL-007400353 at '362 (HCI).

[redacted]

E. Overview of mixers within Google's ad serving stack

84. This section provides an overview of the "mixers"[218] within AdX and DFP that are responsible for collecting ads from different sources and sending them to the auction.[219] [redacted]

[209] Google internal document, "Detailed Design for Narnia2 AFC Serving Stack," GOOG-AT-MDL-019603579 at '582 (HCI).
[210] Google internal document, "Detailed Design for Narnia2 AFC Serving Stack," GOOG-AT-MDL-007275806 at '809 (HCI).
[211] Google internal document, "Detailed Design for Narnia2 AFC Serving Stack," GOOG-AT-MDL-019603579 at '582 (HCI).
[212] Google internal document, "Detailed Design for Narnia2 AFC Serving Stack," GOOG-AT-MDL-019603579 at '582 (HCI).
[213] Google internal document, "Detailed Design for Narnia2 AFC Serving Stack," GOOG-AT-MDL-019603579 at '582 (HCI).
[214] RTB may have access to Google generated user data for frequency capping (making sure a user doesn't see an ad too many times). Google internal document, "Detailed Design for Narnia2 AFC Serving Stack," GOOG-AT-MDL-019603579 at '583 (HCI).
[215] Google internal document, "Google Ad Manager Product Overview," (October 1, 2021) GOOG-AT-MDL-006138947 at '964 (CI).
[216] Google internal document, "Detailed Design for Narnia2 AFC Serving Stack," GOOG-AT-MDL-019603579 at '583 (HCI).
[217] Google internal document, "Display Ads: Unified Identity Service (UIS)," GOOG-AT-MDL-007400353 at '362 (HCI).
[218] Mixers are also called "targeting servers," Google internal document, "AViD Serving Architecture 101 (Backend)," (December 18, 2023) GOOG-AT-MDL-B-005180695 at '696 (HCI).
[219] Google internal document, "DRX Overview," (August 2019) GOOG-TEX-00856580 at '597 (HCI).

[redacted] Figure 9 provides an overview of the mixers bidding into the AdX auction.[222]

Figure 9: Overview of mixers that bid into the Supermixer[223]

[redacted]

85. [redacted].[224] When signing up for RTB in AdX, buyers indicate their pre-targeting criteria, such as language, geographical region, and the requests per second their system can receive.[225] For

[220] Google internal document, "Display Ad Serving: Sellside POV," (July 2022) GOOG-AT-MDL-012693796 at '828 (HCI).
[221] [redacted] Deposition, (April 19, 2024) at 95:13-102:11.
[222] Google internal document, "AViD Serving Architecture 101 (Backend)," (December 18, 2023) GOOG-AT-MDL-B-005180695 at '695 (HCI).
[223] This graphic is not meant to be comprehensive and excludes mixers that are out of the scope for this [redacted]. Google internal document, "AViD Serving Architecture 101 (Backend)," (December 18, 2023) GOOG-AT-MDL-B-005180695 at '695 (HCI).
[224] [redacted]; Google, "Introduction to real-time-bidding (RTB)," https://support.google.com/authorizedbuyers/answer/6136272. Accessed May 23, 2024; [redacted] Deposition, (April 19, 2024) at 120:23-121:4; Google document, "Display Ad Serving: Sellside POV," (July 2022) GOOG-AT-MDL-012693796 at '833 (HCI).
[225] Google, "Introduction to real-time-bidding (RTB)," https://support.google.com/authorizedbuyers/answer/6136272. Accessed May 23, 2024.

example, a buyer may indicate that they would like to receive requests for all impressions served in English in New York. If an impression becomes available that fits the pre-targeting criteria, and the request limit has not been exceeded, the third-party buying tool is invited to place a bid via an external API.[226] The third-party buying tools receive a request that contains:[227]

1) The HTTP header with the referrer URL.[228]

2) Targeting information (*e.g.*, language, geographical region, size, etc.).

3) The truncated IP address of the user.[229]

4) The encrypted user cookie ID.[230]

5) Publisher ad restrictions, such as restricted advertisers or ad types, which are specified by the publisher through the DFP interface. Note that third-party buying tools can still occasionally output an ad that gets blocked.[231]

86. The third-party buying tool analyzes the request and adds additional targeting information it has available. For example, the third-party buying tool may have its own database of targeting information for different websites. The third-party buying tool invokes its bidding algorithm to determine an optimal bid to send to AdX if it decides a suitable advertisement is

[226] Google, "Introduction to real-time-bidding (RTB)," https://support.google.com/authorizedbuyers/answer/6136272. Accessed May 23, 2024; Google internal document, "Introduction to Mixers & SkyRay in AdX," (July 2016) GOOG-AT-MDL-B-005080323 at '326 (CI); An API is a way that two software applications can "talk" to each other. It is an interface for software that can be thought of as a connection point or entry point to access a piece of software programmatically.
[227] Google internal document, "Introduction to Mixers & SkyRay in AdX," (July 2016) GOOG-AT-MDL-B-005080323 at '325 (CI).
[228] This informs the buying tool of the publisher website. HTTP headers contain metadata about the HTTP request. Postman, "What are HTTP headers," (July 11, 2023) https://blog.postman.com/what-are-http-headers/. Accessed May 23, 2024; Google, "Introduction to real-time-bidding (RTB)," https://support.google.com/authorizedbuyers/answer/6136272. Accessed May 23, 2024.
[229] An IP address is a unique address that identifies a device on the internet or a local network. Kaspersky, "What is an IP Address – Definition and Explanation," https://usa.kaspersky.com/resource-center/definitions/what-is-an-ip-address. Accessed May 23, 2024; Google, "Introduction to real-time-bidding (RTB)," https://support.google.com/authorizedbuyers/answer/6136272. Accessed May 23, 2024
[230] Cookies are text files with small pieces of data that are used to identify your computer as you use a network. Kaspersky, "What are Cookies?" https://usa.kaspersky.com/resource-center/definitions/cookies. Accessed May 23, 2024; Google, "Introduction to real-time-bidding (RTB)," https://support.google.com/authorizedbuyers/answer/6136272. Accessed May 23, 2024.
[231] Google internal document, "Introduction to Mixers & SkyRay in AdX," (July 2016) GOOG-AT-MDL-B-005080323 at '327 (CI); Google, "Introduction to real-time-bidding (RTB)," https://support.google.com/authorizedbuyers/answer/6136272. Accessed May 23, 2024.

available.[232] The response the third-party buying tool sends contains the CPM value of the bid and the creative redirect or a Google-hosted creative ID, which allows Google to locate the advertisement to place if the bid wins the final auction.[233]

F. Overview of the [redacted]

87. [redacted]

[redacted]

[redacted]

232 Google, "Introduction to real-time-bidding (RTB)," https://support.google.com/authorizedbuyers/answer/6136272. Accessed May 23, 2024.
233 Google internal document, "Introduction to Mixers & SkyRay in AdX," (July 2016) GOOG-AT-MDL-B-005080323 at '327 (CI); Google, "Introduction to real-time-bidding (RTB)," https://support.google.com/authorizedbuyers/answer/6136272. Accessed May 23, 2024.
234 Google internal document, "AWBid Overview," GOOG-DOJ-14298902 at '907 (HCI); Google internal document, "go/demand-product-design-doc," (January 15, 2018) GOOG-DOJ-14609574 at '578 (HCI).
235 Google document, "go/demand-product-design-doc," (January 15, 2018) GOOG-DOJ-14609574 at '578 (HCI); Google document, "AViD Serving Infrastructure 101 (Backend)," (December 18, 2023) GOOG-AT-MDL-B-005180695 at '701 (HCI)
236 Google internal document, "AWBid Overview," GOOG-DOJ-14298902 at '903 (HCI); Google internal document, "Introduction to Mixers & SkyRay in AdX," (July 2016) GOOG-AT-MDL-B-005080323 at '331 (CI).
237 Google internal document, "Introduction to Mixers & SkyRay in AdX," (July 2016) GOOG-AT-MDL-B-005080323 at '331 (CI).
238 Google internal document, "Introduction to Mixers & SkyRay in AdX," (July 2016) GOOG-AT-MDL-B-005080323 at '327 (CI).
239 Google internal document, "Introduction to Mixers & SkyRay in AdX," (July 2016) GOOG-AT-MDL-B-005080323 at '331 (CI).
240 Google internal document, "Life of a query & Auction Overview," GOOG-AT-MDL-002295716 at '727 (HCI).

[redacted]

88. [redacted]

89. [redacted] ran a modified second-price auction until 2021 and a hybrid first and second-price auction after 2021 due to the auction type changes within AdX.[247] As previously mentioned in Section III.B, until 2019, AdX ran a second-price-style auction. In 2019, AdX switched to a first-

[241] [redacted]

[242] DV360 was previously known as DBM and internally at Google referred to as XBid.

[243] Schonfeld E., techcrunch, "Google Confirms Invite Media Acquisition, Brings Bidding to Display Ads," (June 3, 2010) https://techcrunch.com/2010/06/03/google-confirms-invite-media/. Accessed May 23, 2024; Google internal document, "Introduction to Mixers & SkyRay in AdX," (July 2016) GOOG-AT-MDL-B-005080323 at '334 (CI).

[244] Google internal document, "Introduction to Mixers & SkyRay in AdX," (July 2016) GOOG-AT-MDL-B-005080323 at '334 (CI); Google internal document, "Introduction to Mixers & SkyRay in AdX," (July 2016) GOOG-AT-MDL-B-005080323 at '336 (CI).

[245] In addition to Project SkyRay, Google had several other projects to unify its products. These projects include Project CroNut, Project Amalgam, Project Cramalgam, and Project CroRay. Project CroNut is the unification of DCM and DBM (DV360) products. DoubleClick Campaign Manager (DCM), also known as Campaign Manager 360 and XFA, is a web-based ad management system for advertisers and agencies. Project Amalgam is the unification of Google Ads and Search Ads 360. Search Ads 360 is a tool used by large advertisers to manage search ads. Project Cramalgam is the unification of Project Amalgam and Project CroNut. Project CroRay is the unification of Project CroNut and Project SkyRay. Google internal document, "Cramalgam ACM," (February 2019) GOOG-NE-03632946 at '956 and '962 (HCI); Campaign Manager 360 Help, "Overview of Campaign Manager 360," https://support.google.com/campaignmanager/answer/2709362. Accessed June 6, 2024; Google internal document, "Cramalgam Discussion," (February 2019) GOOG-NE-02345285 at '287 (HCI); Google internal document, "Cramalgam Proposal (draft)," GOOG-NE-02643371 at '371 (HCI); Google internal document, "Supermixer," (January 2020) GOOG-AT-MDL-001421306 at '349 (HCI).

[246] Google internal document, "Pay per Outcome in DBM," (February 10, 2018) GOOG-NE-13620081 at '085 (HCI).

[247] Google internal document, "Cat2 First Price Auction," GOOG-AT-MDL-018531517 at '519 (HCI).

price-style auction model.[248] [redacted]

G. AWBid is a program through which Google Ads bid into third-party exchanges in a limited capacity

90. CAT2 places Google Ads bids in third-party exchanges in a limited capacity through a program called AWBid.[253] AWBid was introduced in 2015 and originally was used only to bid for remarketing ads.[254] Remarketing ads target users that already interacted with an ad for that product and are thus more likely to purchase the product.[255] AWBid also places bids on Project Yavin, which is described in detail in Section IV.H, meaning it places bids directly into publisher ad servers.[256] In late 2018 and early 2019, AWBid was expanded to a broader range of targeting types.[257]

91. [redacted]

[248] Bigler J., "Rolling out first price auctions to Google Ad Manager Partners," (September 5, 2019) https://blog.google/products/admanager/rolling-out-first-price-auctions-google-ad-manager-partners/. Accessed May 23, 2024; Zaiceva A., "First-Price vs. Second-Price Auction | Difference Explained," (April 22, 2021) https://setupad.com/blog/first-price-vs-second-price-auction/. Accessed January 31, 2024.
[249] Google internal document, "Bidding Optimization for TaskAds & Survey," GOOG-DOJ-AT-02246549 at '553 (HCI); Google internal document, "CAT2 1P," (September 29, 2021) GOOG-AT-MDL-001132667 at '669 (HCI).
[250] Google internal document, "CAT2 First Price Auction," GOOG-AT-MDL-018531517 at '519 (HCI).
[251] See Appendix C Section B.16 for confirmation based on my analysis of Google's source code on the [redacted]
[252] See Appendix C Section B.19 for confirmation based on my analysis of Google's source code on Bernanke implementation in 2023.
[253] Google internal document, "AWBid Overview," GOOG-DOJ-14298902 at '903 (HCI).
[254] Google internal document, "AWBid Overview," GOOG-DOJ-14298902 at '903 (HCI); Google internal document, "AWBid," (November 2019) GOOG-NE-13614574 at '586 (HCI); Google internal document, "AWBid Overview," GOOG-DOJ-14298902 at '903 (HCI).
[255] Remarketing is the process of advertising to users that have already expressed interest in one's content, for example already visited the advertiser's website, but have not taken action, such as purchase the product that is being advertised. Cheikha E., Outbrain, "The Remarketing Guide for Dummies," (2023) https://www.outbrain.com/blog/remarketing-guide/. Accessed May 23, 2024.
[256] Google internal document, "AWBid Overview," GOOG-DOJ-14298902 at '903 (HCI).
[257] Google internal document, "AWBid Overview," GOOG-DOJ-14298902 at '903 (HCI). The targeting types are listed as "topic, in-market, affinity, ICM vertical and CIA/CIM targeting types."
[258] Google internal document, "AWBid Type2 Serving," (November 2015) GOOG-AT-MDL-016353371 at '371 (CI).

[redacted]

H. Project "Yavin" is a program through which Google Ads and DV360 are able to buy directly from publishers

92. Google introduced Project "Yavin" in early 2018[263] as a way for DV360 and Google Ads to buy directly from publishers' ad servers.[264] Instead of bidding through AdX, with Yavin, Google Ads and DV360 offer a bid for an impression directly to the publisher's ad server and the publisher can accept or decline.[265] Yavin is invite-only and is intended for "sophisticated publishers."[266]

93. Yavin operates using OpenRTB, which is a technology that facilitates real-time bidding, [redacted].[267] [redacted].[268] [redacted]

[259] Google internal document, "AWBid Type2 Serving," (November 2015) GOOG-AT-MDL-016353371 at '372 (CI).
[260] Google internal document, "AWBid Type2 Serving," (November 2015) GOOG-AT-MDL-016353371 at '373 (CI).
[261] Google internal document, "AWBid Overview," GOOG-DOJ-14298902 at '907 (HCI).
[262] Google internal document, "AWBid Overview," GOOG-DOJ-14298902 at '907 (HCI). A "creative" is another term for an ad and includes the media file (*e.g.*, image or video) to display. Google, "What are creatives?" https://support.google.com/admanager/answer/3185155?hl=en. Accessed June 7, 2024.
[263] [redacted] Deposition, (April 23, 2024) at 58:25-59:14; Google internal document, "Sellside Launch Doc: Demand Product," GOOG-AT-MDL-003991554 at '554 (CI) see "Links" section which has Ariane Launch code;
Google internal workbook, " ArianeDownload....," GOOG-AT-MDL-018219666 at Row 291 shows corresponding Ariane Launch code with launch date "Feb 1, 2018" and status "Launched." (HCI)
[264] Google proposed launching Yavin for AdX RTB demand, therefore making Yavin serving accessible to third-party buyers in AdX. Google internal document, "AdX Demand on Yavin," (December 8, 2017) GOOG-NE-12065295 at '296 (HCI); Google internal document, "Demand Product (Project Yavin)," (January 15, 2018) GOOG-AT-MDL-009754910 at '913 (HCI); Google internal document, "Roadmap for AdX demand on Yavin," (May 9, 2019) GOOG-DOJ-AT-02148683 at '683 (HCI).
[265] Google internal document, "eBay/Google," (December 2017) GOOG-DOJ-27712490 at '493 (CI).
[266] Google internal document, "eBay/Google," (December 2017) GOOG-DOJ-27712490 at '493 (CI).
[267] Google internal document, "Demand Product (Project Yavin)," (January 15, 2018) GOOG-AT-MDL-009754910 at '913 (HCI).
[268] Google internal document, "Demand product for dummies," (February 2018) GOOG-AT-MDL-003109989 at '000 (HCI).

[redacted] Bids placed via Yavin are first-price, meaning that if the bid is accepted, the advertiser will pay the value of the bid.[270] [redacted].[271]

94. Although Yavin enabled Google buying tools to buy directly from publishers' own ad servers, it was not widely used by publishers. Publishers had to enter a contract with Google to use Yavin and the program required "custom integrations between Google and each customer's ad server[.]" As of April 2024, since Yavin was introduced in 2018, I understand that only [redacted] publishers had signed Yavin contracts: [redacted]; the latter [redacted] publishers were not based in the United States.[272] Each of the [redacted] publishers' Yavin integrations are no longer live and running.[273]

I. DV360 PPO is a program through which DV360 advertisers can pay for outcomes, such as clicks, instead of views

95. As previously mentioned, in 2019 DV360 began offering the option for their advertisers to "pay-per-outcome" (PPO), similarly to payment options offered in Google Ads.[274] Instead of paying per impression, advertisers could choose to pay per specific outcomes related to their campaign goals – in other words, they can choose to pay only if their target user performs a desired action. For example, advertisers can pay for clicks, conversions or installs instead of impressions. In order to place a bid from an ad with a PPO campaign into an exchange that requires bids in CPM, DV360 can use a conversion algorithm to determine an equivalent bid in CPM. [redacted]

[269] Google internal document, "Demand product for dummies," (February 2018) GOOG-AT-MDL-003109989 at '002 (HCI).
[270] Google internal document, "Demand product for dummies," (February 2018) GOOG-AT-MDL-003109989 at '993 (HCI).
[271] Google internal document, "Demand product for dummies," (February 2018) GOOG-AT-MDL-003109989 at '002 (HCI).
[272] [redacted] Deposition, (April 23, 2024) at 58:25-59:14; Google internal workbook, GOOG-AT-MDL-018630622 (HCI).
[273] 3 [redacted] Deposition, (April 23, 2024) at 59:17-61:3.
[274] Google Marketing Platform, "Improve Campaign performance with new automated bidding solutions," (September 2019) https://blog.google/products/marketingplatform/360/improve-campaign-performance-new-automated-bidding-solutions/. Accessed May 23, 2024.

[redacted] Figure 10 demonstrates the ad serving process after DV360 PPO was introduced.[276]

[redacted]

96. According to Google's public documentation, outcome-based buying for DV360 was discontinued in July 2023.[278]

J. Google's ad serving functionality changed over time

97. Google's ad serving functionality has gone through many changes over time as Google acquired new products and introduced new auction rules, mechanics and technologies that affected the ad serving process. These changes include the introduction of Enhanced Dynamic Allocation, Header Bidding, Exchange Bidding, and Unified Pricing Rules, among others, all of which significantly modified the process through which impressions are bought and sold. The changes introduced by these programs and technologies are described in detail in Sections VII, VIII, IX, and XIV. respectively. Here, I provide a high-level overview of the ways in which these programs and technologies changed the ad serving process. Figure 11 depicts a timeline of the implementation of the auction serving changes. Figure 12 shows an overview of the ad serving process and the order in which auction steps occur.

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[275] Google internal document, "CAT2 1P," (September 29, 2021) GOOG-AT-MDL-001132667 at '672 (CI).
[276] Google internal document, "CAT2 1P," (September 29, 2021) GOOG-AT-MDL-001132667 at '672 (CI). Some documents refer to CAT2 as the Google Ads auction, excluding DV360, while other documents show DV360 bidding through CAT2 after the transition of DV360 to the Google Ads stack in 2014-2017.
[277] Google internal document, "CAT2 1P," (September 29, 2021) GOOG-AT-MDL-001132667 at '672 (CI). This diagram simplifies the serving process to demonstrate the general way in which DV360 PPO competes with Google Ads.
[278] Display & Video 360 Help, "What's new: July 2023," (July 2023) https://support.google.com/displayvideo/answer/13840246. Accessed May 23, 2024.

98. The "waterfall auction" was the earliest way publishers sold inventory that had not already been sold via direct deals.[279] The waterfall auction involves passing an ad request from demand source to demand source (ad exchange or network) until it is filled.[280] Prior to the introduction of Dynamic Allocation and later the emergence of Header Bidding and Exchange Bidding, waterfalls were the only method publishers could use to fill inventory that was not sold through direct deals.[281] To set up a waterfall, publishers generated line items within DFP with CPMs that were based on the historical performance of each exchange.[282]

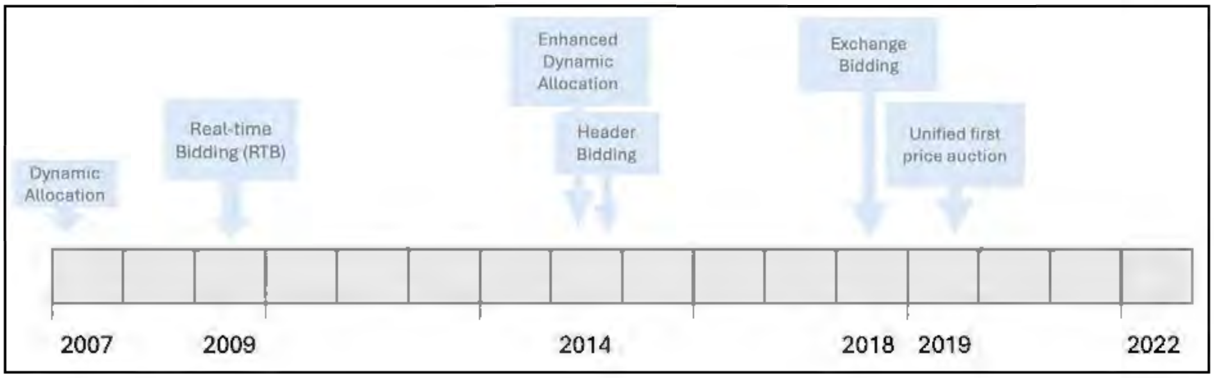
99. As an example of a waterfall configuration, if Exchange A historically returns $2.00 bids, and Exchange B historically returns $1.00 bids, a publisher may choose to pass their impression first to Exchange A, and if it is unable to fill the impression, it would pass the impression to Exchange B. An impression would be passed from exchange to exchange until one of the exchanges could fill the impression at or above the floor price, at which point the advertisement would be served to the user.

100. With the introduction of Header Bidding and Exchange Bidding, third-party ad networks and exchanges gained the opportunity to compete for DFP publisher's inventory in real-time, alongside AdX.[283] Instead of using historical performance to determine an order for demand sources, all demand sources submit bids simultaneously.[284] However, a complex system of prioritization still determines the outcome of the auction.

101. Figure 11 below shows a high-level timeline of major changes to Google's ad serving functionality. In the next section, I provide a step-by-step overview of the current ad serving process.

[279] Google document, "Clearing Up Misconceptions About Google's Ad Tech Business," (May 5, 2020) GOOG-NE-10780865 at '878-879 (HCI).
[280] Google document, "Clearing Up Misconceptions About Google's Ad Tech Business," (May 5, 2020) GOOG-NE-10780865 at '878-879 (HCI).
[281] Google document, "Clearing Up Misconceptions About Google's Ad Tech Business," (May 5, 2020) GOOG-NE-10780865 at '878-879 (HCI).
[282] Google document, "Clearing Up Misconceptions About Google's Ad Tech Business," (May 5, 2020) GOOG-NE-10780865 at '878-879 (HCI).
[283] Zaiceva A., setupad, "Header Bidding vs. Waterfall | Difference Explained," (July 17, 2021) https://setupad.com/blog/header-bidding-vs-waterfall/. Accessed May 23, 2024; Google Ad Manager Help, "Introduction to Open Bidding," https://support.google.com/admanager/answer/7128453. Accessed May 23, 2024.
[284] Zaiceva A., setupad, "Header Bidding vs. Waterfall | Difference Explained," (July 17, 2021) https://setupad.com/blog/header-bidding-vs-waterfall/. Accessed May 23, 2024.

Figure 11: Timeline of major changes to ad serving functionality[285,286]



K. Overview of Google's display ad serving process

102. When a user opens a website with advertisements, such as an online newspaper, an ad request is sent to the publisher's ad server that procures bids from a variety of sources, selecting one to be rendered on the page.[287] Google, which owns both an ad server and ad exchange, has a complex serving stack that enables this process, and this stack has undergone many changes over the years as Google integrated acquired products and developed their technology.

103. The following outlines the steps that occur once the user's browser loads the publisher's webpage:[288]

1) An impression becomes available on the publisher's webpage.

2) If the publisher participates in Header Bidding, the Header Bidding code on the webpage pauses the GPT tag from calling DFP and sends bid requests to the publisher's Header Bidding partners first.[289]

i. Header Bidding, introduced around 2014 and widely adopted around 2015, allowed publishers to send ad requests to multiple exchanges and networks to compete in a singular auction, outside of GAM, prior to sending an ad request to DFP.[290] To implement Header Bidding, publishers must include an HTML tag with

285 Placement of events is approximate.
286 Additionally, in 2012 the OpenRTB Standard was adopted by Interactive Advertising Bureau (IAB), the advertising organization providing industry standards, research and professional development, and promoting the growth of interactive advertising for its hundreds of member companies.
287 Google internal document, "Ad Manager Ecosystem 101," GOOG-AT-MDL-001004706 at '767 (HCI).
288 Google internal document, "Ad Manager Ecosystem 101," GOOG-AT-MDL-001004706 at '767 (HCI).
289 Google internal document, "Ad Manager Ecosystem 101," GOOG-AT-MDL-001004706 at '767 (HCI).
290 Zaiceva A., Setupad, "What is Header Bidding? | A Complete Guide for Publishers," (April 4, 2022) https://setupad.com/blog/what-is-header-bidding/. Accessed May 23, 2024.

JavaScript code called a "Header Bidding tag" on their page that is used to communicate with one or more Header Bidding partners.[291] Header Bidding is described in detail in Section VIII.

3) The Header Bidding bids are returned to the browser.

4) The GPT tag sends an ad request to DFP, which includes the Header Bidding response.[292]

5) DFP invokes Enhanced Dynamic Allocation, which estimates a CPM value for both guaranteed and remnant line items.[293]

i. Enhanced Dynamic Allocation ("EDA") was introduced on March 3, 2014 and allows AdX and remnant line items to compete with guaranteed line items in real-time.[294] An in-depth description of Dynamic Allocation and Enhanced Dynamic Allocation are provided in Sections VI and VII.

104. DFP constructs a bid request that contains price floor information. Price floor information is determined by a variety of factors including the CPM values calculated by EDA, publisher-set pricing rules and floors determined by Google's "optimization" models (such as RPO). Price floors and RPO are discussed in detail in Sections XIII and XIV.

1) The bid request is sent to AdX, which in turn collects bids from Google (Google Ads and DV360) buyers, Authorized Buyers, and Exchange Bidding buyers.

i. Authorized Buyers are ad networks and other platforms that are allowed to buy on behalf of multiple advertisers in AdX using real-time bidding.[295] As they represent multiple advertisers, Authorized Buyers do not use Google's buying tools such as Google Ads and DV360.

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[291] Zaiceva A., Setupad, "What is Header Bidding? | A Complete Guide for Publishers," (April 4, 2022) https://setupad.com/blog/what-is-header-bidding/. Accessed May 23, 2024.
[292] Google internal document, "Ad Manager Ecosystem 101," GOOG-AT-MDL-001004706 at '767 (HCI); see Section IV.A on line items. Google internal document, "Ad Manager Ecosystem 101," GOOG-AT-MDL-001004706 at '767 (HCI)
[293] Google internal document, "Ad Manager Ecosystem 101," GOOG-AT-MDL-001004706 at '741 (HCI).
294 Google's First Amended Responses and Objections to Plaintiff's Third Set of Interrogatories, (May 24, 2024) at 11.
[295] Google, "Authorized Buyers overview," https://support.google.com/authorizedbuyers/answer/6138000?hl=en. Accessed May 30, 2024.

ii. Exchange Bidding ("EB"), also known as Open Bidding ("OB"), was launched in February 2018 and was Google's server-side alternative to Header Bidding.[296] It allows third-party exchanges to compete for ad slots alongside AdX in real-time. Exchange Bidding is described in detail in Section IX.

2) DFP runs a single unified auction, in which AdX demand, Exchange Bidding demand, remnant and guaranteed line items all compete against one another on a first-price basis.[297] The highest bid wins the auction.

i. The unified first-price auction and Unified Pricing Rules (UPR) were introduced in May 2019.[298] Under UPR, the publisher-set floor applies to all indirect demand, which includes Exchange Bidding participants, remnant line items (including Header Bidding, where third-party buyers can submit bids in real-time), and the AdX auction.[299] Therefore, all demand sources compete in a final first-price auction with a single floor.[300] I describe the unified auction and Unified Pricing Rules in greater detail in Section XIV.

3) The ad from the winning demand or line item is served. DFP constructs a response to the original ad request, which contains the ad to be served or a link for the browser to download the ad.[301]

i. To select the ad to serve, DFP filters the ads corresponding to the winning demand, accounting for the size of the ad, the format of the ad, and whether the ad has already been shown elsewhere on the page.[302] If the winning demand has at

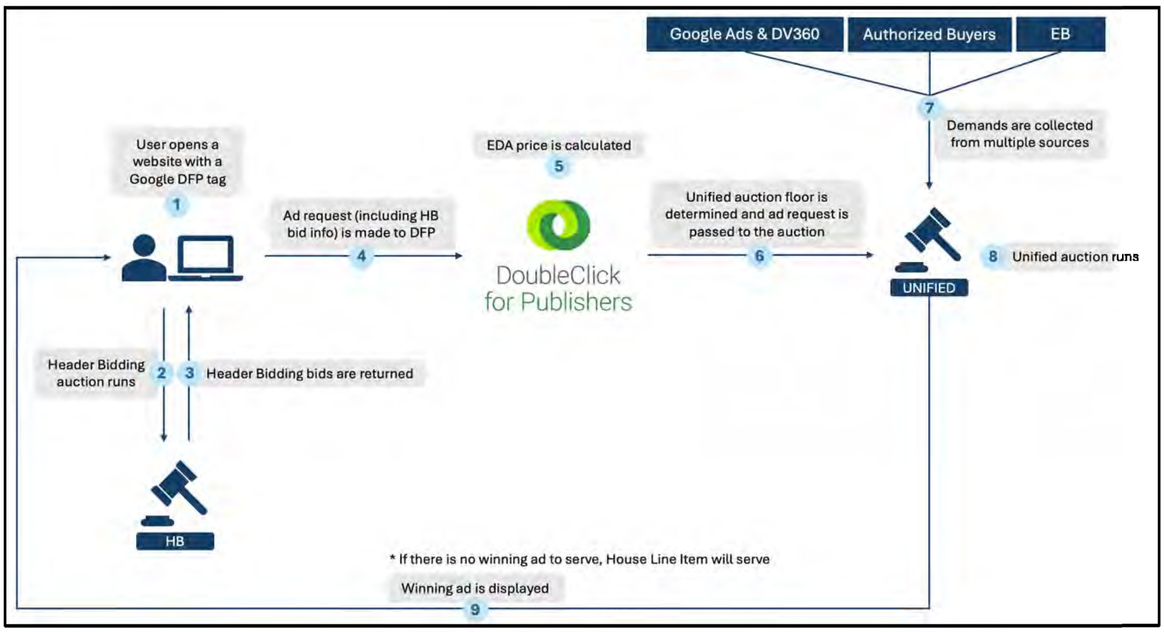
[296] Google's First Amended Responses and Objections to Plaintiff's Third Set of Interrogatories, (May 24, 2024) at 11. Note that the open beta for Exchange Bidding, which was available to all publishers using DFP, was released in June 2017; Cox, S., "Announcing Exchange Bidding open beta," (June 8, 2017) https://blog.google/products/admanager/announcing-exchange-bidding-open-beta/. Accessed May 23, 2024.
[297] Google internal document, "Skyray Overview," GOOG-TEX-00217546 at '551 (HCI).
[298] Google internal document, "Unified 1st Price Auction," (September 3, 2019) GOOG-DOJ-AT-01812188 at '195 (HCI).
[299] Google Ad Manager Help, "Unified pricing rules," https://support.google.com/admanager/answer/9298008. Accessed May 23, 2024.
[300] Google internal document, "1st Price Migration," GOOG-DOJ-28243636 at '645 (CI).
[301] Google, "Ad selection white paper," https://support.google.com/admanager/answer/1143651?sjid=16185194441614631351-NA. Accessed June 6, 2024.
[302] Google, "Ad selection white paper," https://support.google.com/admanager/answer/1143651?sjid=16185194441614631351-NA. Accessed June 6, 2024.

least one ad available after filtering, the ad will serve.[303] Otherwise, DFP moves to the next best demand or line item from the auction and repeats the filtering process until an ad is available.[304]

ii. Occasionally, no AdX demand, Exchange Bidding demand, guaranteed line item, or remnant line item wins the auction. In these cases, a House line item, which usually contains an ad for the publisher's own website or products, serves the impression.[305]

105. Figure 12 below gives a high-level overview of this process.

Figure 12: Overview of Google display ad serving process[306]



V. GOOGLE UNIFIED ITS AD SERVER AND AD EXCHANGE INTO A SINGLE PRODUCT

303 Google, "Ad selection white paper," https://support.google.com/admanager/answer/1143651?sjid=16185194441614631351-NA. Accessed June 6, 2024.
304 Google, "Ad selection white paper," https://support.google.com/admanager/answer/1143651?sjid=16185194441614631351-NA. Accessed June 6, 2024.
305 Google internal document, "Ad Manager Ecosystem 101," GOOG-AT-MDL-001004706 at '719 (HCI); Google, "House line items," https://support.google.com/admanager/answer/79305?hl=en. Accessed May 23, 2024.
306 Google internal document, "Ad Manager Ecosystem 101," GOOG-AT-MDL-001004706 at '767 (HCI).

106. In the early days of Google's ad stack, AdX was designed to interoperate with third-party ad servers and ad networks. Over time, Google consolidated its products, culminating in the unification of DFP and AdX into GAM.[307] However, as Google proceeded with unification, AdX's capability to interoperate with third party platforms stagnated over time.

A. AdX was initially built on top of Google's existing ad stack as an intermediary between publishers and advertisers

107. By the time Google acquired DoubleClick in 2007, Google had already developed several advertising technologies of its own.[308] Among those technologies were AdSense, released in 2003, and AdWords, released in 2000;[309] these technologies are described earlier in Section III. Originally, AdSense and AdWords solely interacted with each other as the seller and buyer, respectively.[310]

108. In 2009, Google rebuilt the AdX technology it acquired from DoubleClick and released it as a new version of AdX.[311] This version of AdX included several new features, including a new user interface (UI), application programming interface (API), ad server, reporting system, and real-time bidding engine.[312] As an exchange, AdX introduced the possibility for indirect deals: in addition to direct deals, publishers and advertisers could now participate in auctions for inventory.[313] Advertisers, including those using AdWords, would submit bids to AdX for inventory from various publishers, including those using AdSense.[314] In other words, AdSense sellers could access AdX bids, while AdWords buyers could access AdX inventory.[315]

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307 [redacted] Deposition, (April 12, 2024) at 137:14-138:18.
308 Google, "Google to Acquire DoubleClick," (April 13, 2007) https://googlepress.blogspot.com/2007/04/google-to-acquire-doubleclick_13.html. Accessed May 23, 2024.
309 Google, "Google Expands Advertising Monetization Program for Websites," (June 18, 2003) https://googlepress.blogspot.com/2003/06/google-expands-advertising-monetization.html. Accessed May 23, 2024; Google, "Google Launches Self-Service Advertising Program," (October 23, 2000) https://googlepress.blogspot.com/2000/10/google-launches-self-service.html. Accessed May 23, 2024.
310 Google internal document, "Ad Exchange Update," (May 5, 2009) GOOG-NE-06567200 at '202 (HCI); Google internal document, "Responses to Questions 1, 4-25, 28-36, and 39-52 of the Autorite de la Concurrence's Request for Information dated 23 July 2019 Case No. 19/0030F," (July 23, 2019) GOOG-DOJ-05782415 at '421 (CI).
311 Google internal document, "Ad Exchange 2.0 Design Document," GOOG-NE-05241093 at '093 (HCI).
312 Google internal document, "Ad Exchange 2.0," GOOG-NE-11839088 at '089 (HCI).
313 "The Advertising Exchange - providing a common trading platform and set of controls for the indirect sales channel allows sellers to expose inventory to the largest possible universe of buyers on their own terms." Google internal document, "Ad Exchange Update," (May 5, 2009) GOOG-NE-06567200 at '201 (HCI).
314 Google internal document, "Ad Exchange Update," (May 5, 2009) GOOG-NE-06567200 at '202 (HCI).
315 Google internal document, "Ad Exchange Update," (May 5, 2009) GOOG-NE-06567200 at '202 (HCI).

109. AdX was built on top of Google's existing ad stack to connect publishers and advertisers, and had similarities with Google's existing products, AdSense and AdWords.[316] For example, AdX's sell-side UI was similar to AdSense's UI, and AdX's buy-side UI was similar to AdWords' UI.[317] Using these UIs, sellers could list inventory as ad units and allocate inventory for auction via AdSense or AdX, while buyers could bid on inventory allocated via AdWords or AdX.[318]

110. Although AdX was connected to the rest of Google's ecosystem, a publisher did not have to use AdSense and an advertiser did not have to use AdWords to use AdX. For example, on the buy-side AdX accepted bids from a variety of ad networks and buying tools, all bids were equalized to the ad slot's minimum CPM minus the buyer cost to determine whether they would be accepted into the auction, and all accepted bids ran in the same auction.[319] Third-party demand side platforms would interact with AdX through a real-time bidding (RTB) API, where AdX would pass the buyer information such as the user's IP address and cookie, and the buyer would pass AdX information such as the bid and ad to be served, should the buyer win the auction.[320]

111. [redacted]

112. AdX could also integrate with DFP, though the two platforms remained separate at the time. AdX integrated with DFP in the sense that AdX ads could compete with directly sold DFP ads at a specified priority level, and the ad with the highest yield would be served through Dynamic

316 Google internal document, "Ad Exchange Update," (May 5, 2009) GOOG-NE-06567200 at '203 (HCI).
317 "The initial development of the exchange will focus on only the spot market and a sub-set of the buy-side and sell-side tools, accessed via a user interface similar to AdWords (AW) / AdSense (AS) front-ends." Google internal document, "Ad Exchange 2.0 Design Document," GOOG-NE-05241093 at '094 (HCI); Google internal document, "Ad Exchange Update," (May 5, 2009) GOOG-NE-06567200 at '203 (HCI).
318 Google internal document, "Ad Exchange 2.0 Design Document," GOOG-NE-05241093 at '096 (HCI).
319 Google internal document, "Ad Exchange Update," (May 5, 2009) GOOG-NE-06567200 at '207-208 (HCI).
320 Google internal document, "Ad Exchange 2.0," GOOG-NE-11839088 at '099-101 (HCI).
321 [redacted] Deposition, (May 23, 2024) at 142:4-14; 147:1-9.

Allocation, a feature exclusive to DFP discussed in detail in Section VI.[322] A transaction for an impression would trigger when a user visited a webpage with a tag from DFP.[323] AdX would then be checked for matching buyers for bids that were above the minimum CPM of the ad slot and that satisfied all targeting criteria set by the publisher.[324] For each matching buyer, if the bid net of revenue share was higher than the value of the ad booked directly in DFP, the AdX buyer would win the auction.

113. It was also possible for publishers to use AdX without using DFP, and AdX was originally designed such that it could be used regardless of whether a publisher used DFP and or a third-party ad server.[325] If the publisher was using a non-DFP ad server as its primary ad server, the ad server could communicate with AdX using an AdX callout integration that interacted with an AdX API.[326] When the publisher's ad server called the API, the ad server would send data including the minimum CPM, restrictions, and information on the impression.[327] In response to the API call from the ad server, AdX would return the two highest bids for the impression and a "pointer" to the ad associated with the highest bid.

114. Thus, AdX was designed to integrate with Google's existing ad stack, including AdSense, AdWords, and DFP. However, at the time of AdX's launch publishers and advertisers did not have to use Google's existing ad stack to use AdX, and could use their own buying tools, ad networks, and/or ad servers.

B. Google unified DFP and AdX into GAM

115. As early as 2014, Google made the decision to unify DFP and AdX into a single platform.[328] Google's efforts resulted in the release of GAM in 2018. Some GAM features included:[329]

322 Google internal document, "Seller Migration Training," GOOG-AT-MDL-015236044 at '078 (CI).
323 Google internal document, "Ad Exchange 2.0 Design Document," GOOG-NE-05241093 at '096-097 (HCI).
324 Google internal document, "Ad Exchange 2.0 Design Document," GOOG-NE-05241093 at '096-097 (HCI).
325 Google document, "Ad Exchange 2.0 Design Document," GOOG-NE-05241093 at '096-097 (HCI).
326 Google document, "The Display Advertising Opportunity," GOOG-NE-02110867 at '877 (HCI).
327 Google document, "Ad Exchange 2.0 Design Document," GOOG-NE-05241093 at '096-097 (HCI).
328 Google document, "Vision for Tagging Infrastructure," (June 16, 2014) GOOG-TEX-00260934 at '934 (HCI); [redacted] Deposition, (April 12, 2024) at 146:24-147:12.
329 Bellack, J., "Introducing Google Ad Manager," (June 27, 2018) https://blog.google/products/admanager/introducing-google-ad-manager/. Accessed May 23, 2024.

1) Programmatic solutions such as "[Google's] programmatic deals framework to features like Optimized Competition that help [publishers] maximize yield across reservations, private marketplaces, and the open auction."[330]

2) Features to "curate who has access to [publishers'] inventory, alongside all [publishers'] reservation and programmatic demand, and optimize [publishers'] relationships for yield."

3) A platform for publishers to deliver, measure, and optimize ads for their audiences.

4) Features to manage ads' alignment with publishers' brand values and protect user safety.

116. Additionally, Google built a single UI from which users could access both DFP and AdX.[331] Google stated that this UI would allow for a "seamless transition" between DFP and AdX to save publishers time from tasks such as fixing errors or manual data entry.[332]

117. Google also integrated DFP and AdX's ad serving infrastructure over time. [redacted]

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330 "Optimized Competition is a suite of features in GAM that include systems such as Dynamic Allocation and First Look." Google, "Optimized competition," https://support.google.com/admanager/answer/7422526. Accessed May 23, 2024.
331 Google internal document, "DFP and AdX Integration," GOOG-TEX-00045314 at '333 (HCI).
332 Google internal document, "DFP and AdX Integration," GOOG-TEX-00045314 at '333 (HCI).
333 Google internal document, "Project AURAS: A Unified Reservation/Auction Stack," GOOG-DOJ-13615596 at '597 (HCI).
334 Google internal document, "Project AURAS: A Unified Reservation/Auction Stack," GOOG-DOJ-13615596 at '597 (HCI); Google internal document, "go/demand-product-design-doc," (January 15, 2018) GOOG-DOJ-14609574 at '578 (HCI). Note that CAT2 BOW and CAT2 Supermixer were also known as AFC (AdSense for Content) BOW and Supermixer respectively.
335 "At a high level [,] the goal for AURAS is to change the way DFP retrieves ads from our auction products. Historically, it has made an HTTPOverRPC call to CAT2 BOW ... and received a fully rendered ad that it must serve[.]" Google internal document, "Project AURAS: A Unified Reservation/Auction Stack," GOOG-DOJ-13615596 at '597 (HCI).
336 Google internal document, "Auras," (April 9, 2021) GOOG-AT-MDL-B-005180709 at '709 (HCI).

1) [redacted]

[redacted]

118. Thus, Google unified DFP and AdX by integrating their ad serving stacks into one, and then building additional features on top of the unified stack. This culminated in the release of GAM.

C. Google reinforced the DFP-AdX unification using GPT tags

119. While Google was unifying DFP and AdX's ad serving stacks, Google changed its implementation of ad tags such that they would be used to direct traffic to GAM. As discussed in Section IV.B, ad tags are pieces of code placed on a publisher's website to communicate with an ad server and send ad requests. Google offered several types of tags, including the GPT tag and the AdX tag. To reiterate, GPT tags were introduced to replace DFP tags and function by sending a request to DFP, which then sends a backfill call to AdX. On the other hand, AdX tags do not send ad requests to DFP, but instead enable publishers to use AdX with a third-party ad server instead of DFP: this method of using AdX as a standalone product is also known as "AdX Direct."[342]

[337] Google internal document, "Project AURAS: A Unified Reservation/Auction Stack," GOOG-DOJ-13615596 at '600 (HCI); Google internal document, "Display Ad Serving: Sellside POV," (July 2022) GOOG-AT-MDL-012693796 at '829 (HCI).
[338] Google internal document, "Project AURAS: A Unified Reservation/Auction Stack," GOOG-DOJ-13615596 at '600 (HCI).
[339] Google internal document, "Project AURAS: A Unified Reservation/Auction Stack," GOOG-DOJ-13615596 at '600 (HCI); Google internal document, "Display Ad Serving: Sellside POV," (July 2022) GOOG-AT-MDL-012693796 at '829 (HCI).
[340] Google internal document, "Project AURAS: A Unified Reservation/Auction Stack," GOOG-DOJ-13615596 at '600, '603 (HCI).
[341] Google internal document, "Project AURAS: A Unified Reservation/Auction Stack," (2018) GOOG-DOJ-13615596 at '606-607 (HCI); Google internal document, "Display Ad Serving: Sellside POV," (July 2022) GOOG-AT-MDL-012693796 at '829 (HCI).
[342] Google internal document, "AdX Direct Review," (February 11, 2020) GOOG-DOJ-27799214 at '215 (CI); [redacted] Deposition, (April 12, 2024) at 323:3-330:16; 331:11-14.

120. AdX tags are therefore embedded in websites of publishers that use non-Google ad servers. [redacted]

[redacted]

121. Although AdX tags allow publishers to use ad servers other than DFP, they have several functional limitations compared to GPT tags. [redacted]

[343] Google internal document, "go/demand-product-design-doc," (January 15, 2018) GOOG-DOJ-14609574 at '577 (HCI); Google internal document, "Project AURAS: A Unified Reservation/Auction Stack," GOOG-DOJ-13615596 at '597 (HCI). [redacted]

[344] Google internal document, "go/demand-product-design-doc," (January 15, 2018) GOOG-DOJ-14609574 at '577 (HCI); Google internal document, "Project AURAS: A Unified Reservation/Auction Stack," GOOG-DOJ-13615596 at '597 (HCI).

[345] Google internal document, "go/demand-product-design-doc," (January 15, 2018) GOOG-DOJ-14609574 at '577 (HCI); Google internal document, "Project AURAS: A Unified Reservation/Auction Stack," GOOG-DOJ-13615596 at '597 (HCI). Note that CAT2 BOW was also known as AFC BOW, and CAT2 Supermixer was also known as Supermixer.

[redacted] Similarly, ad requests sent by AdX tags are ineligible for DFP deals such as Programmatic Guaranteed and Preferred Deals, which further restricts the types of demand available to AdX tag users.[347] As another example, Exchange Bidding (Open Bidding), Google's server-side solution to allow third-party exchanges to bid alongside AdX, was not available through AdX tags.[348] This meant that publishers using AdX tags could not access third-party exchanges through AdX. Thus, though AdX tags allowed AdX to be interoperable with third-party ad servers, publishers using AdX tags did not have access to all the features included with GPT tags.

122. By the time Google made the decision to unify DFP and AdX in 2014, Google proposed that "all publishers should be using effectively a single tag."[349] This single tag was the GPT tag. Google explored several solutions to direct traffic through the GPT tag, including:

1) [redacted]

[346] Google internal document, "Responses to Questions 1, 4-25, 28-36, and 39-52 of the Autorite de la Concurrence's Request for Information dated 23 July 2019 Case No. 19/0030F," (July 23, 2019) GOOG-DOJ-05782415 at '439 (CI).
[347] "If you have an AdX tag on a page, and DFP ad units that were created because they are mapped to the adx ad slot that matches that tag and then target the ad unit in PD or PG, it won't break, but the deal would never get called b/c the tag is not eligible for those types of deals[.]" Google internal document, "Ad Unit Stuff (go/ad-unit-stuff)," GOOG-AT-MDL-004288612 at '643 (CI).
[348] Google internal document, "AdX Direct Review," (February 11, 2020) GOOG-DOJ-27799214 at '217 (CI).
[349] Google internal document, "Vision for Tagging Infrastructure," (June 16, 2014) GOOG-TEX-00260934 at '934 (HCI).
[350] Google internal document, "Vision for Tagging Infrastructure," (June 16, 2014) GOOG-TEX-00260934 at '957 (HCI).
[351] Google internal document, "Vision for Tagging Infrastructure," (June 16, 2014) GOOG-TEX-00260934 at '958 (HCI).
[352] Google internal document, "Vision for Tagging Infrastructure," (June 16, 2014) GOOG-TEX-00260934 at '977-978 (HCI).

2) [redacted]

123. These solutions made up Google's "GPT-for-AdX" project. To prioritize this strategy, Google proposed "postponing some feature and revenue projects to allow an immediate focus on GPT-for-AdX."[356] Google also proposed building tools to facilitate the migration from AdX tags to GPT tags, where an AdX tag on a publisher's webpage would be converted to a GPT tag.[357] Google considered building such a tool using third-party ad servers' APIs or making the tool open source for third parties to build on.[358]

124. Google's efforts to have publishers use GPT tags was a key component of its "own the tag" strategy, which meant "placing the Google Publisher Tag (GPT) on the page directly so Google owns the decision logic via DFP across all demand sources."[359] Google's transition to GPT tags and "own the tag" strategy also reinforced DFP's unification with AdX into GAM. By routing traffic to DFP, Google would determine "whether to serve a directly sold ad (programmatic or tag based) or an indirect ad[.]"[360] Then, by unifying DFP with AdX, ad requests routed to DFP would also be passed to AdX.

353 Google internal document, "Vision for Tagging Infrastructure," (June 16, 2014) GOOG-TEX-00260934 at '967 (HCI).
354 Google internal document, "Vision for Tagging Infrastructure," (June 16, 2014) GOOG-TEX-00260934 at '977-978 (HCI).
355 Google internal document, "Vision for Tagging Infrastructure," (June 16, 2014) GOOG-TEX-00260934 at '977-978 (HCI).
356 Google internal document, "Vision for Tagging Infrastructure," (June 16, 2014) GOOG-TEX-00260934 at '973 (HCI).
357 Google internal document, "Vision for Tagging Infrastructure," (June 16, 2014) GOOG-TEX-00260934 at '964 (HCI).
358 "Have you dug into what ad server the pubs with the largest % of AdX tags use? It might be more useful to build a tool that does this using their APIs. Or open source the tool you're suggesting to let third parties build on it[.]" Google internal document, "Vision for Tagging Infrastructure," (June 16, 2014) GOOG-TEX-00260934 at '964 (HCI).
359 Google internal document, GOOG-DOJ-28420330 at '338 (CI).
360 Google internal document, GOOG-DOJ-28420330 at '338 (CI).

D. AdX interoperability with third parties stagnated over time

125. As discussed in Section V.A, AdX was initially designed to be interoperable with third parties, including those that did not use DFP, AdSense, or AdWords. However, as Google developed its "own the tag strategy" and unified DFP and AdX, third party interoperability stagnated over time.

126. As discussed above in Section V.A, when AdX initially launched publishers could access AdX with a third-party ad server using an AdX API. For years after AdX's launch, Google recognized that this sell-side API was an "increasingly critical part of the business for our publishers and the 3rd parties who help us create a robust ecosystem."[361] However, Google also stated that it was unclear how long the API would continue to be supported and that it was possible for the API to be internally deprecated.[362] One reason for the lack of continued support for the API and its eventual deprecation was the unification of DFP and AdX into GAM.[363] For example, a feature allowing AdX partners to efficiently manage domains was not planned to be implemented in the AdX API "in light of the DFP+AdX unification project."[364] Thus, Google focused on unification and routing traffic through its ad stack from top to bottom.

127. AdX tags and AdX Direct also experienced a similar lack of support over time. As discussed in Section V.C, publishers using AdX tags did not have access to all the features available through DFP and GAM, including DA / EDA and Exchange Bidding. As discussed in Sections VI, VII, and IX, these features allowed publishers to compete in real-time and enabled publishers to solicit bids from third-party exchanges in addition to AdX buyers, respectively. Thus, although AdX tags allowed publishers to use AdX without using DFP, they had limited functionality compared to using AdX and DFP together in GAM. Currently, AdX tags are still in use, and it is still possible for publishers to use AdX with a third-party ad server.[365] However, the lack of key features for AdX tags compared to GPT tags means that publishers making direct requests to AdX ultimately have fewer opportunities to maximize their yield and revenue.

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[361] Google internal document, "DRK PM Personal One-Pagers 2016," (June 2016) GOOG-DOJ-28486025 at '049 (CI).
[362] Google internal document, "DRK PM Personal One-Pagers 2016," (June 2016) GOOG-DOJ-28486025 at '049 (CI).
[363] "Unification brings DFP and AdX into a single UI and ultimately will deprecate the AdX API." Google internal document, "Per account ICS access," GOOG-NE-13216501 (HCI).
[364] Google internal document, GOOG-AT-MDL-007365338 at '366 (HCI).
[365] Google, "Generate Ad Exchange ad tags," https://support.google.com/admanager/answer/7501422. Accessed May 30, 2024.

VI. DYNAMIC ALLOCATION ALLOWS ADX TO COMPETE WITH REMNANT LINE ITEMS IN REAL-TIME

128. Dynamic Allocation (DA) is a mechanism within Google's DFP ad server that enables AdX and remnant line items to compete in real-time for ad impressions that were not fulfilled by guaranteed line items.[366]

A. Ad serving logic is traditionally governed by the ad waterfall process

129. Ad waterfalls, also known as daisy chains, are a process used by publishers to sell all their remnant inventory when they are unable to sell their premium ad slots, which are usually reserved for direct ad sales. The process was introduced to reduce the number of unfilled ad spaces and thus increase revenue opportunities for publishers. In a waterfall process, as its name suggests, demand sources (*e.g.*, ad networks and ad exchanges) are initiated one after another in a waterfall-like pattern to solicit bids for an impression.[367] To that end, if a publisher is unable to sell inventory via direct sales, they will then pass the ad impression down the waterfall to the next demand source. This process will continue until one of two situations are met. If a demand source can provide a suitable ad for the impression, then its ad is displayed on the dedicated ad space. Otherwise, if no demand sources can provide an impression, then the publisher displays an ad promoting its own products or services, which are referred to as "fallback" or "House" ads.[368]

130. Although waterfall auctions helped establish early ad serving logic, they have several technical limitations. One key disadvantage is that waterfall auctions are prone to latency, error, and timeout issues. This is because each stage of the waterfall takes time to load, so each stage increases the time it takes for an impression to be served. Another disadvantage is that the CPMs for each demand source and the order in which demand sources are called are typically set by the publisher based on average historical performance (for example, the average revenue generated per impression sold from a particular demand source) or a pre-negotiated price with a demand source.[369] Consequently, it is possible for a lower-ranking demand source willing to pay more for an impression to lose to a higher-ranking source that pays less.

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[366] Google internal document, "Clearing Up Misconceptions About Google's Ad Tech Business," (May 5, 2020) GOOG-NE-10780865 at '881 (HCI); [redacted] Deposition, (May 23, 2024) at 105:11-108:16; [redacted] Deposition, (April 26, 2024) at 101:3-9.
[367] Google internal document, "Mediation and Exchange Bidding in DRX," (October 18, 2017) GOOG-AT-MDL-001110980 at '981 and '982 (CI).
[368] Google Ad Manager Help, "House line items," https://support.google.com/admanager/answer/79305?hl=en. Accessed June 6, 2024.
[369] Google internal document, "Clearing Up Misconceptions About Google's Ad Tech Business," (May 5, 2020) GOOG-NE-10780865 at '878-879 (HCI).

B. Dynamic Allocation enables AdX to compete with remnant inventory in real-time

131. Dynamic Allocation (DA) was first launched by DoubleClick on July 11, 2007 as a purported solution to various inefficiencies in the traditional ad waterfall process.[370] Google states that DA solved these inefficiencies by allowing AdX and remnant line items (inclusive of third-party exchanges and networks, as detailed in Section VI.A) to compete against each other in real-time for an impression unfulfilled by a guaranteed line item.[371]

132. Google states that when DA was initially launched by DoubleClick, there was no "standard protocol that allowed non-AdX ad exchanges to integrate with DFP."[372] Thus, at the time AdX was the only exchange with the "technical capability to submit real-time bids into DFP."[373] Since DA was a core part of DFP and AdX since its initial launch, the only way for publishers to not use DA was to not call AdX.[374]

133. DA proceeded in the following steps:

1) DFP determined if there was a guaranteed line item eligible to fulfill an ad impression. As discussed in Section IV.A, guaranteed line items are contractually obligated to deliver a specified number of impressions. If such a guaranteed line item existed, DA would not run.[375]

2) Otherwise, a floor price was calculated based on the highest net value CPM (vCPM) of the publisher's remnant line items.[376] The vCPM was first specified by publishers, either

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[370] Google internal document, "Clearing Up Misconceptions About Google's Ad Tech Business," (May 5, 2020) GOOG-NE-10780865 at '880 (HCI); [redacted] Deposition, (May 23, 2024) at 105:11-108:16; Google's First Amended Responses and Objections to Plaintiff's Third Set of Interrogatories, (May 24, 2024) at 11.
[371] Google internal document, "Clearing Up Misconceptions About Google's Ad Tech Business," (May 5, 2020) GOOG-NE-10780865 at '881 (HCI).
[372] Google internal document, "Digital Advertising Market Study: Follow-up to Google/CMA meeting on 28 October 2019," GOOG-AT-MDL-006690096 at '096 (CI); Standard protocols for real-time bidding were developed several years after the launch of DA. The OpenRTB protocol is an example of such a protocol; IAB Tech Lab, "OpenRTB," https://iabtechlab.com/standards/openrtb/. Accessed May 23, 2024; Google, "OpenRTB Integration," https://developers.google.com/authorized-buyers/rtb/openrtb-guide. Accessed May 23, 2024.
[373] Google internal document, "Digital Advertising Market Study: Follow-up to Google/CMA meeting on 28 October 2019," GOOG-AT-MDL-006690096 at '096 (CI).
[374] [redacted] Deposition, (May 2, 2024) at 395:5-398:22.
[375] Google internal document, "Clearing Up Misconceptions About Google's Ad Tech Business," (May 5, 2020) GOOG-NE-10780865 at '881 (HCI).
[376] See Appendix C Section B.6 for findings based on my analysis of Google's source code on the calculation of vCPM in DA.

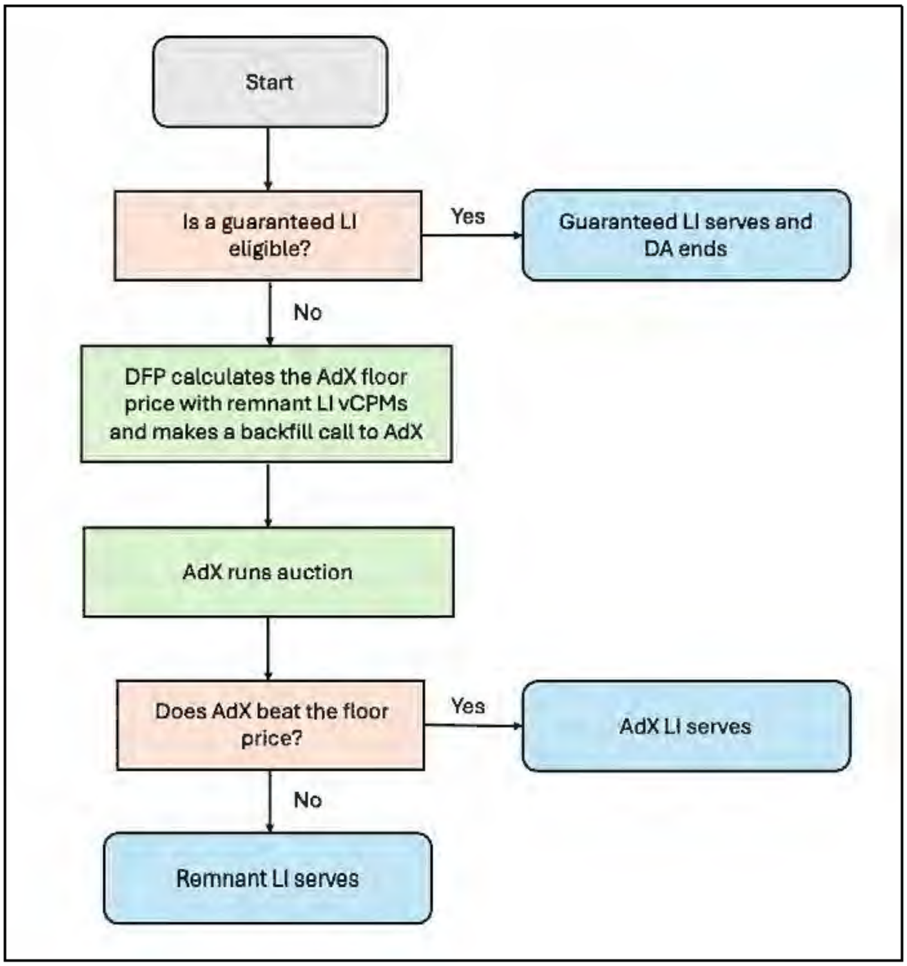
as the pre-negotiated CPM price with the line item's corresponding demand partner or as an estimate of the CPM the line item would likely generate based on historical performance.[377] [redacted]

3) AdX ran an auction to select the winning bidder. If the highest bid from AdX was above the floor price, even if only by a single penny, then AdX won the impression. Otherwise, the static remnant line item with the highest vCPM or a negotiated price won.[383] An ad corresponding to the winning AdX demand or the remnant line item would be served, as discussed in Section IV.K.

134. Figure 14 below illustrates the process of DA as a flowchart.

[377] Google internal document, "Clearing Up Misconceptions About Google's Ad Tech Business," (May 5, 2020) GOOG-NE-10780865 at '881 (HCI); Google, "Value CPM," https://support.google.com/admanager/answer/177222. Accessed May 23, 2024; See Appendix C Section B.5 for findings from my analysis of Google's source code on vCPM specified by publishers.
[378] See Appendix C Section B.6 for findings from my analysis of Google's source code on the calculation of vCPM in DA; See Appendix C Section B.7 for findings from my analysis of Google's source code on the calculation of vCPM and DA floor price.
[379] Google, "Clickthrough rate (CTR): Definition," https://support.google.com/google-ads/answer/2615875. Accessed May 23, 2024; [redacted] Deposition, (April 3, 2024) at 145:6-148:22.
[380] "[Backfill is defined as:] Inventory that has not been pre-sold or reserved. As a verb, 'backfill' means to serve ads to this inventory. Backfill inventory is often monetized with ads sold by ad networks, via non-guaranteed campaigns, or in an auction." Google, "Glossary," https://support.google.com/admanager/table/7636513. Accessed May 23, 2024.
[381] See Appendix C Section B.2 for findings from my analysis of Google's source code on the data representation of the backfill call.
[382] Google sometimes refers to DA as "backfill" in internal documents. Google internal document, "Mysteries of Dynamic Allocation SOLVED," (December 15, 2011) GOOG-TEX-00074558 at '562 (HCI); See Appendix C Section B.1 for findings from my analysis of Google's source code, where I verified the backfill type and call flow. AdX buyers were only involved in line item backfill. Google internal document, "Mysteries of Dynamic Allocation SOLVED," (December 15, 2011) GOOG-TEX-00074558 at '562 (HCI).
[383] Google internal document, "Clearing Up Misconceptions About Google's Ad Tech Business," (May 5, 2020) GOOG-NE-10780865 at '881 (HCI).

Figure 14: Dynamic Allocation flowchart[384]



135. Google viewed DA as limiting because DA would not be called if there was a guaranteed line item eligible to fulfill an impression. In other words, neither AdX nor remnant line items could compete with guaranteed line items.[385] For AdX to compete with guaranteed line items, Google created a more comprehensive version of DA known as Enhanced Dynamic Allocation (EDA), as discussed in Section VII.

[384] Google internal document, "Clearing Up Misconceptions About Google's Ad Tech Business," (May 5, 2020) GOOG-NE-10780865 at '881 (HCI); Google internal document, "Mysteries of Dynamic Allocation SOLVED," (December 15, 2011) GOOG-TEX-00074558 at '562 (HCI).
[385] Google internal document, "Clearing Up Misconceptions About Google's Ad Tech Business," (May 5, 2020) GOOG-NE-10780865 at '880-882 (HCI).

C. After acquiring AdMeld, Google developed Third-Party Dynamic Allocation to allow AdMeld publishers to access real-time AdX demand but it was ultimately not launched

136. In June 2011, Google acquired a platform called AdMeld.[386] Google described AdMeld as a "yield manager" that helped publishers manage inventory sales.[387] In particular, AdMeld supported real-time bidding since 2009 and was capable of handling bids from multiple demand sources (including DSPs and ad networks) to compete in a single real-time auction.[388]

137. After acquiring AdMeld, Google began developing a project called "AdX Connect" or "Third-Party Dynamic Allocation" (3PDA) as an interim integration of AdMeld into Google's ad serving stack.[389] 3PDA would have allowed AdX buyers to compete with demand sources buying through AdMeld in an AdMeld-hosted auction for AdMeld publisher inventory.[390] However, 3PDA was not released to the general public: it was announced in March 2012, remained in limited beta in April 2012, and was deprecated in October 2013 when Google shut down AdMeld entirely.[391,392]

VII. ENHANCED DYNAMIC ALLOCATION ENABLES ADX AND REMNANT LINE ITEMS TO COMPETE WITH GUARANTEED LINE ITEMS IN REAL-TIME

386 Google, "Helping publishers get the most from display advertising with Admeld," (June 13, 2011) https://googleblog.blogspot.com/2011/06/helping-publishers-get-most-from.html. Accessed June 3, 2024.
387 Google, "Helping publishers get the most from display advertising with Admeld," (June 13, 2011) https://googleblog.blogspot.com/2011/06/helping-publishers-get-most-from.html. Accessed June 3, 2024; AdMeld, "Superior Technology, Superior Results," https://web.archive.org/web/20101225163051/http://www.admeld.com/technology.html. Accessed May 31, 2024; Google internal document, "Programmatic - AdX - RTB - DSP," (March 20, 2013) GOOG-AT-MDL-012530559 at '569 (CI).
388 AdMeld, "Superior Technology, Superior Results," https://web.archive.org/web/20101225163051/http://www.admeld.com/technology.html. Accessed May 31, 2024.
389 Google internal document, "AdX Connect Comms Doc," (April 26, 2012) GOOG-AT-MDL-017084371 at '371-372 (CI).
390 Google internal document, "AdX Connect Comms Doc," (April 26, 2012) GOOG-AT-MDL-017084371 at '371-372 (CI).
391 Google internal document, "AdX Connect Comms Doc," (April 26, 2012) GOOG-AT-MDL-017084371 at '371-372 (CI).
392 Google internal document, "Recap of Ads Deals 2005-2013," (February 2014) GOOG-AT-MDL-004122442 at '444 (CI).

138. Google introduced Enhanced Dynamic Allocation (EDA)[393] in March 2014.[394] EDA allowed both AdX and remnant line items to also compete against guaranteed line items while protecting guaranteed line items' campaign goals.[395]

139. Internal Google documents indicate that after the EDA launch, Google pushed publishers to switch from DA to EDA to "get all [publishers] on EDA and make it the default DA."[396] As a result, Google moved all its publishers to EDA by September 2016.[397] This section describes the EDA process in detail and how it allows AdX and remnant line items to compete with guaranteed line items in real-time.

140. The EDA process has changed over time, particularly in 2019 when Google switched to Unified Pricing Rules and first-price auctions as discussed in Section XIV. Before 2019, EDA occurred with the following steps:

141. DFP calculated a temporary CPM (tCPM) for each guaranteed line item and selected the guaranteed line item with the highest tCPM.[398] The tCPM values represented estimated opportunity costs for not serving a guaranteed line item in favor of an AdX or other remnant line

[393] In the past, Enhanced Dynamic Allocation was also referred to by Google internally as Cross-Priority Ranking as it enabled line items of different priorities to compete with one another. See Google internal document, "Enhanced Dynamic Allocation Overview (EDA)," (March 13, 2017) GOOG-TEX-00830552 at '552 (HCI); All mentions of the term "DA" or "Dynamic Allocation" in Google's internal documents and official webpages after 2014 refer to Enhanced Dynamic Allocation.
[394] Google's First Amended Responses and Objections to Plaintiff's Third Set of Interrogatories, (May 24, 2024) at 11.
[395] Google internal document, "Yield Management in Google Ad Manager," (November 2018) GOOG-AT-MDL-000993483 at '489 (HCI).
[396] Google internal document, "[OLD] – Meeting Notes – DRX Indirect Commercialization," (December 18, 2017)
GOOG-TEX-00971457 at '586 (HCI).
[397] Google internal document, "GPSI Bi-Weekly Snippets," (June 9, 2017) GOOG-NE-09149436 at '537 (HCI).
[398] This value has also been called the "EDA price" in Google documents, which is "at least the PG [Programmatic Guaranteed] price, plus the opportunity cost determined by how far behind/ahead-schedule this PG deal is." Google internal document, "EDA for Programmatic Guaranteed Deals," GOOG-AT-MDL-009013305 at '308 (HCI).

item.[399] The more behind schedule a guaranteed line item was, the higher its tCPM value.[400] [redacted]

[redacted]

2) [redacted]

3) [redacted]

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[399] Google internal document, "AdX Buy-side Commercialization," GOOG-NE-04415172 at '316 (HCI).
[400] Google internal document, "Yield Management in Google Ad Manager," (November 2018) GOOG-AT-MDL-000993483 at '489 (HCI); "Dynamic allocation protects delivery of guaranteed line items by automatically adjusting the temporary CPM. Therefore, a guaranteed line item that is behind schedule wins often enough to stay on pace to satisfy its goal and pacing settings." Google, "Ad competition with dynamic allocation," https://support.google.com/admanager/answer/3721872. Accessed May 23, 2024; [redacted] Deposition, (May 2, 2024) at 383:3-18.
[401] Google internal document, "DRX Ad Ranking and Auction Introduction," (October 2019) GOOG-DOJ-AT-00167982 at '994 (HCI); Google internal document, "Yield Management in Google Ad Manager," (November 2018) GOOG-AT-MDL-000993483 at '489 (HCI).
[402] See Appendix C Section B.17 for findings from my analysis of Google's source code on the calculation of tCPM in EDA.
[403] See Appendix C Section B.8 for findings from my analysis of Google's source code on the calculation of acceptance probability.
[404] "If the temporary CPM is too high, Ad Manager doesn't call Ad Exchange, which explains why sometimes the number of 'Impressions competing' is lower than the 'Eligible impressions' in reports." Google, "Ad competition with dynamic allocation," https://support.google.com/admanager/answer/3721872. Accessed May 23, 2024.
[405] See Appendix C Section B.18 for findings from source code analysis on ad selection process and impact of acceptance probability in EDA.
[406] Google internal document, "Yield Management in Google Ad Manager," (November 2018) GOOG-AT-MDL-000993483 at '489 (HCI).
[407] See Appendix C Section B.9 for findings from my analysis of Google's source code on the calculation of vCPM in EDA.

4) [redacted]

[redacted]

1) [redacted]

2) [redacted]

[redacted]

ii. [redacted]

408 Google document, "Display Ad Serving: Sellside POV," (July 2022) GOOG-AT-MDL-012693796 at '824 (HCI).
409 Google internal document, "EDA for Programmatic Guaranteed Deals," GOOG-AT-MDL-009013305 at '308 (HCI).
410 Google internal document, "Display Ad Serving: Sellside POV," (July 2022) GOOG-AT-MDL-012693796 at '826-827 (HCI).
411 Google internal document, "EDA for Programmatic Guaranteed Deals," GOOG-AT-MDL-009013305 at '308 (HCI).
412 Google internal document, "EDA for Programmatic Guaranteed Deals," GOOG-AT-MDL-009013305 at '308 (HCI).
413 Google internal document, "EDA for Programmatic Guaranteed Deals," GOOG-AT-MDL-009013305 at '308 (HCI).
414 See Appendix C Section B.10 for findings from my analysis of Google's source code on the calculation of the EDA floor price.
415 Google internal document, "Cross Priority Ranking," (November 2011) GOOG-NE-02343690 at '691-692 (HCI). In this document, "Pa" is the highest tCPM and "MRP" is the highest vCPM.

[redacted]

143. From this process, it is evident that EDA enabled AdX to compete in real-time with guaranteed line items and remnant line items for inventory. If AdX beat the floor decided by either the price from a guaranteed line item or remnant line item, it would immediately win the impression. Figure 15 illustrates the EDA process before 2019.

[416] Google internal document, "Cross Priority Ranking," (November 2011) GOOG-NE-02343690 at '692 (HCI).

[redacted]

144. Google stated that EDA enables AdX buyers to bid on more DFP impressions and access more inventory.[418] However, EDA still presented some limitations for publishers. For example,

[417] Google internal document, "Enhanced Dynamic Allocation," (November 6, 2017) GOOG-DOJ-AT-02368104 at '106 (HCI).
[418] Google internal document, "Launch First Price Auction and Unified Pricing Rules," GOOG-DOJ-AT-00599602 at '607 (HCI).

Google acknowledged that publishers may not get the highest price that all other demand sources (such as guaranteed and remnant) might be willing to pay for the inventory.[419] This was because AdX competed for impressions using real-time bids while guaranteed and remnant line items competed using static bids with tCPM values, which were calculated by DFP using information such as historical bids and campaign progress, and vCPM values, which as discussed in Section VI.B incorporates estimates from publishers. As a result, the tCPM and vCPM values may not represent what these demand sources might have paid for the impression if they were allowed to bid in real-time. Publishers would lose out on revenue in situations where a third-party demand source would bid above its historical average CPM, such as when remarketing high bids.[420]

A. Publishers cannot disable Enhanced Dynamic Allocation

145. There was no straightforward way for publishers to disable or turn off EDA. At the time of EDA's initial launch, Google stated that for publishers "[t]he default is EDA on, all new networks have it on."[421] Due to the way EDA was designed, enabling publishers to opt out of EDA without losing access to certain planned features, such as programmatically transacting guaranteed line items,[422] would require additional engineering logic added to the AdX auction.[423] However, Google also states that implementing such accommodations was "certainly not impossible."[424]

146. The only way EDA could be disabled was through an internal Google system called ICS, which was used by Google engineers to view and modify a publisher's setup configurations.[425] This system was not accessible to publishers directly.

147. Some publishers opted out of EDA for some time during its initial launch and rollout.[426] Around the time of EDA's initial launch in 2014, [redacted] publishers had opted out; by November 2015 there were [redacted] Publishers that opted out of EDA's initial launch included [redacted],

[419] Google internal document, "Comms Doc: Header Bidding – Work in Progress," (August 2016) GOOG-NE-11797719 at '724 (HCI).
[420] Google internal email, "Re: EDA - how valuable is it to us?," GOOG-DOJ-15432462 at '463 (HCI).
[421] Google internal email, "Re: EDA rollout plan," GOOG-DOJ-14141075 at '076 (HCI).
[422] Project Jordan was an internal name for a feature that allowed publishers to transact guaranteed line items programmatically. [redacted] Deposition, (May 2, 2024) at 462:21-463:4.
[423] Google internal email, "Re: EDA rollout plan," GOOG-DOJ-14141075 at '075 (HCI).
[424] Google internal email, "Re: EDA rollout plan," GOOG-DOJ-14141075 at '075 (HCI).
[425] "The default is EDA on, all new networks have it on. It can be turned off in ICS, but we don't want to mention it as an option." Google internal email, "Re: EDA rollout plan," GOOG-DOJ-14141075 at '076 (HCI); [redacted] Deposition, (May 2, 2024) at 459:13-25.
[426] [redacted] Deposition, (May 2, 2024) at 455:7-456:22.
[427] Google internal document, "[OLD] - Meeting Notes - DRX Indirect Commercialization," GOOG-TEX-00971457 at '586 (HCI).

[redacted]. [428] Google transitioned all publishers to EDA by 2016.

148. At present, publishers are still unable to opt out of EDA within the GAM interface.[429] If a publisher wished to use AdX without EDA, they could do so with AdX tags;[430] while this offers publishers a way to circumvent EDA, as discussed in Section IV.C, AdX tags have limited functionality compared to GPT tags. Alternatively, publishers using GAM could disable AdX for a single impression by configuring GAM and AdX settings to exclude AdX from the impression's sales process.[431]

B. Before 2019, Last Look incorporated the best remnant line item's vCPM into the AdX auction floor price

149. As discussed in Section VII, one of the steps in EDA was selecting the remnant line item with the highest vCPM. This vCPM was used to inform the AdX auction price floor by comparing it to the highest tCPM from a guaranteed line item. The process of informing the AdX auction price floor with the highest vCPM was known as Last Look.

150. Last Look and the incorporation of the best remnant line item's vCPM into the AdX auction floor price proceeded in the following steps:

151. As discussed in Section VII, DFP selected the remnant line item with the highest vCPM.[432] Generally, remnant line items represent information on non-guaranteed ad campaigns, as discussed in Section IV.A. However, starting in 2014 remnant line items could also be used to represent bids from third-party exchanges in first-price auctions outside of Google's ad stack.[433] To bid in such an auction, third-party exchanges and networks used non-Google technologies such

[428] Google internal workbook, "EDA Enhanced Dynamic Allocation - Temp," GOOG-TEX-00055792 (HCI).
[429] Google internal document, "Responses to Questions 1, 4-25, 28-36, and 39-52 of the Autorite de la Concurrence's Request for Information dated 23 July 2019 Case No. 19/0030F," (July 23, 2019) GOOG-DOJ-05782415 at '437 (CI).
[430] Google document, "Responses to Questions 1, 4-25, 28-36, and 39-52 of the Autorite de la Concurrence's Request for Information dated 23 July 2019 Case No. 19/0030F," (July 23, 2019) GOOG-DOJ-05782415 at '437 (CI).
[431] Google document, "Responses to Questions 1, 4-25, 28-36, and 39-52 of the Autorite de la Concurrence's Request for Information dated 23 July 2019 Case No. 19/0030F," (July 23, 2019) GOOG-DOJ-05782415 at '438 (CI).
[432] Google internal document, "Yield Management in Google Ad Manager," (November 2018) GOOG-AT-MDL-000993483 at '489 (HCI); See Appendix C Section B.10 for findings from my analysis of Google's source code on the calculation of vCPM in EDA.
[433] Google internal document, "First-price bidding," GOOG-TEX-00949710 at '713 (HCI).

as Header Bidding.[434] The winning bid from the remnant line item, *e.g.*, a bid from Header Bidding, would be sent to DFP and matched with a remnant line item.[435] Header Bidding is discussed in detail in Section VIII.

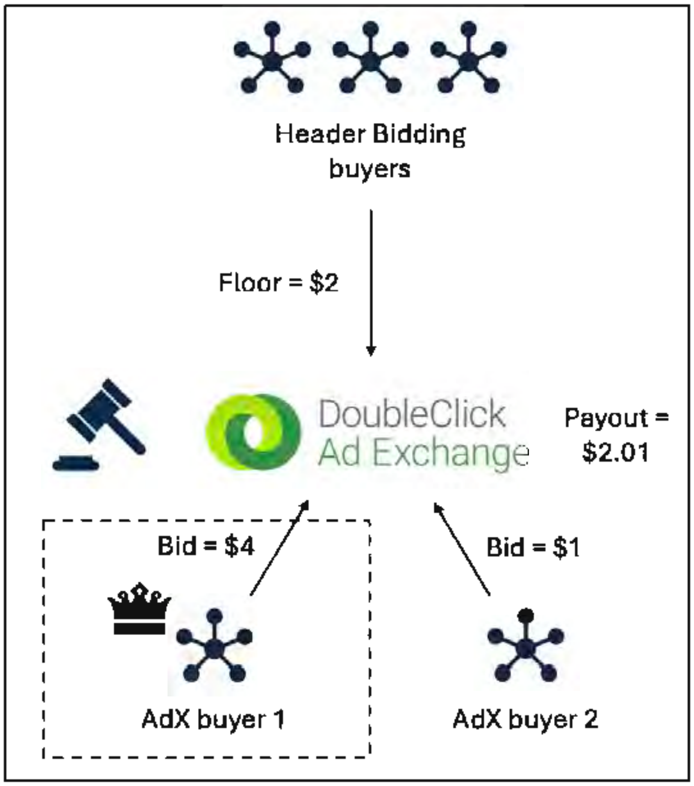
1) The highest vCPM was compared to the highest tCPM from a guaranteed line item to inform the AdX auction price floor, as discussed in Section VII.

2) AdX then ran a modified second-price auction among its buyers using the price floor. The auction outcomes are described in Section VII.

152. Thus, Last Look incorporated third-party buyers' bids by receiving auction results from external sources such as Header Bidding and used them to floor AdX's own auction. This provided AdX buyers with visibility into third-party buyers' prices before the AdX buyers submitted their own bids. This led to situations where AdX won an auction it would have otherwise lost, absent Last Look. Consider a simplified example where third-party buyers bid for an impression in a first-price auction through Header Bidding, and the winning bid of this auction is $2. This bid gets passed into DFP and is matched with a remnant line item. Suppose this remnant line item has the highest vCPM. Following Last Look, if this vCPM was greater than the highest tCPM of a guaranteed line item, then the $2 vCPM was passed to AdX as the price floor. If the AdX auction had two buyers, with the first buyer bidding $4 and the second buyer bidding $1, then the first AdX buyer would win the auction because its bid was higher than both the second AdX buyer and the price floor. Moreover, the winning AdX buyer would only pay a cent above the price floor, even though it was willing to pay more. This scenario is shown in Figure 16 below.

[434] Google internal document, "First-price bidding," GOOG-TEX-00949710 at '713 (HCI).
[435] Google internal document, "When the game changes: How HB affects Yield management in DRX," GOOG-AT-MDL-000993446 at '458, '478 (CI).

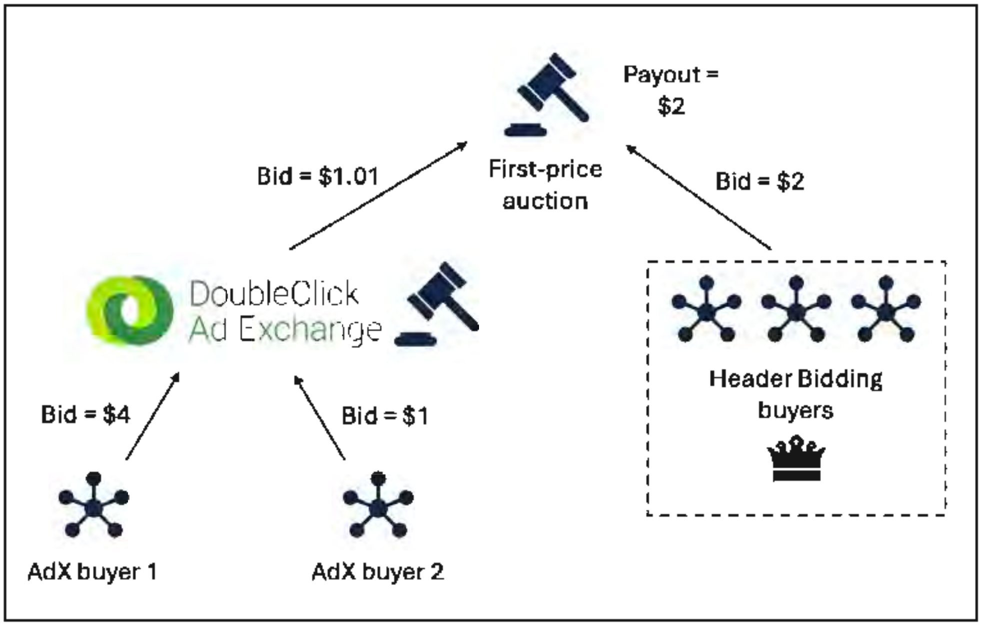
Figure 16: AdX winning auction with Last Look[436]



153. However, absent Last Look, the result of AdX's own auction may have competed in real-time against the result of the Header Bidding auction by third-party buyers. Then AdX's second-price bid, $1, would compete against Header Bidding's first-price bid, $2, and AdX would lose. AdX would effectively be unable to use information from third-party exchanges in Header Bidding in its own auction. This scenario is shown in Figure 17 below.

[436] Google internal document, "First-price bidding," GOOG-TEX-00949710 at '713 (HCI).

Figure 17: AdX losing auction without Last Look[437]



154. However, there was one exception: Last Look did not use bids submitted by third-party buyers using a Google program called Exchange Bidding to inform the AdX auction price floor. As discussed in detail in Section IX, Exchange Bidding was Google's response to Header Bidding and allowed third-party exchanges to compete in real-time alongside AdX. By February 2017, four months before Google launched the Exchange Bidding open beta for all publishers using DFP,[438] Google stopped using bids from Exchange Bidding buyers to calculate the EDA floor price.[439] Thus, AdX had a "Last Look" over Header Bidding bids but not Exchange Bidding bids.

155. In fact, when Exchange Bidding was initially launched, DFP sent Exchange Bidding participants the EDA floor price and the best remnant price to inform Exchange Bidding auctions.[440] Thus, not only did Google use Exchange Bidding buyers' bids in non-Google auctions to floor AdX auctions, but Google also provided Exchange Bidding buyers information on bids from non-Google (Header Bidding) auctions.

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[437] Google internal document, "First-price bidding," GOOG-TEX-00949710 at '717 (HCI).
[438] Cox, S., "Announcing Exchange Bidding open beta," (June 8, 2017) https://blog.google/products/admanager/announcing-exchange-bidding-open-beta/. Accessed May 23, 2024.
[439] See Appendix C Section B.11 for findings from my analysis of Google's source code on the removal of last look over Exchange Bidding buyers.
[440] Google internal document, "1st Price Migration," GOOG-DOJ-28243636 at '640 (CI).

C. From 2019 onwards, Google removed Last Look from Enhanced Dynamic Allocation after transitioning to first-price auctions

156. In 2019, Google transitioned from running second-price auctions in AdX to running "unified" first-price auctions.[441] In doing so, Google stated that "no price from any of a publisher's non-guaranteed advertising sources, including non-guaranteed line item prices, will be shared with another buyer before they bid in the auction," effectively removing Last Look from EDA.[442] This meant that the remnant line item vCPMs would no longer be used to floor the AdX auction.[443]

157. After removing Last Look, the EDA process occurs as follows:

1) [redacted].[444]

2) [redacted]."[446]

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[441] Bigler, J., "An update on first price auctions for Google Ad Manager," (May 10, 2019) https://blog.google/products/admanager/update-first-price-auctions-google-ad-manager/. Accessed May 30, 2024.
[442] Bigler, J., "An update on first price auctions for Google Ad Manager," (May 10, 2019) https://blog.google/products/admanager/update-first-price-auctions-google-ad-manager/. Accessed May 30, 2024.
[443] "The reserve price is at least the maximum of the temporary CPM calculated by Ad Manager for the best eligible guaranteed line item or the floor price configured by the publisher (as may be adjusted, at the publisher's option, by various Ad Manager optimizations). The reserve price is not set by either the value CPMs of remnant line items that are competing for the impression." Google, "How Open Bidding works," https://support.google.com/admanager/answer/7128958. Accessed May 23, 2024.
[444] "The reserve price for Ad Exchange ads is at least the temporary CPM from [the best guaranteed line item]." Google, "How we decide which ad is served," https://support.google.com/admanager/answer/11204312. Accessed May 23, 2024.
[445] Google, "How we decide which ad is served," https://support.google.com/admanager/answer/11204312. Accessed May 23, 2024; Google, "About campaign goal types," https://support.google.com/admob/answer/9152820. Accessed May 23, 2024; [redacted] Deposition, (May 2, 2024) at 74:22-76:5.
[446] Google, "How we decide which ad is served," https://support.google.com/admanager/answer/11204312. Accessed May 23, 2024.

3) [redacted]

4) [redacted].[450]

5) [redacted].

158. I understand that Enhanced Dynamic Allocation is still in use today.[452] The dynamics of the AdX first-price auction are discussed further in Section XIV.

VIII. HEADER BIDDING ALLOWS PUBLISHERS TO OFFER THEIR AD INVENTORY TO MULTIPLE EXCHANGES SIMULTANEOUSLY

159. This section discusses Header Bidding in detail. The section covers Header Bidding's use cases within the ad serving system, how Header Bidding is implemented at a technical level, and how data flows between publishers and advertisers under Header Bidding.

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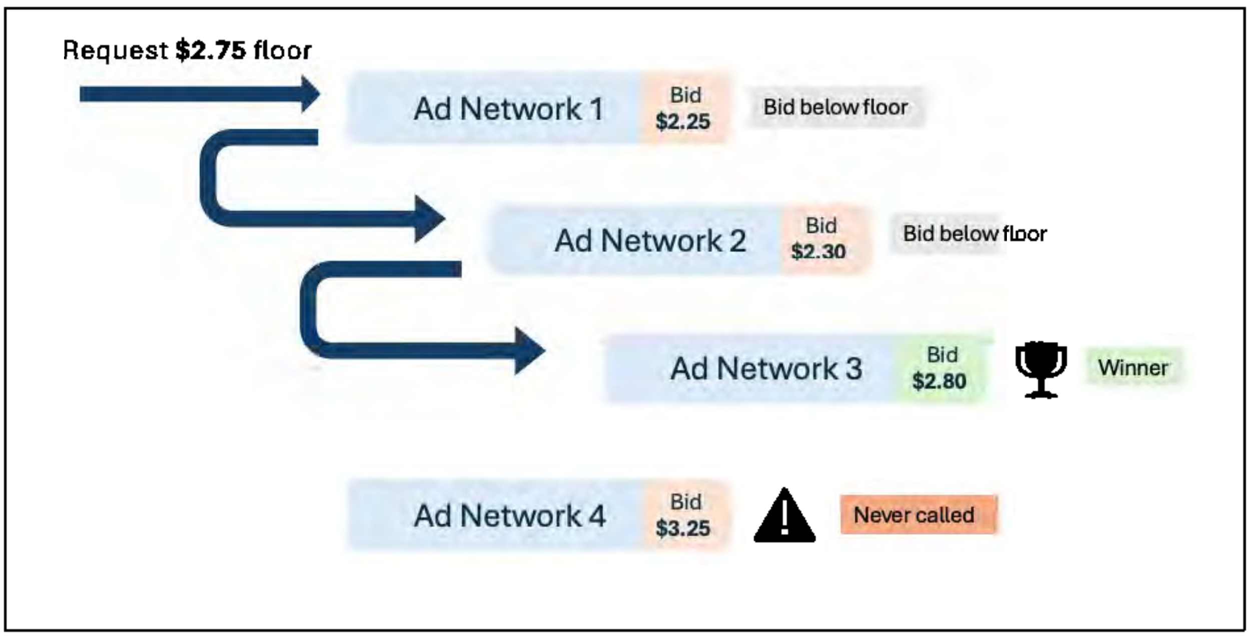
[447] Google, "How we decide which ad is served," https://support.google.com/admanager/answer/11204312. Accessed May 23, 2024.
[448] Google, "How we decide which ad is served," https://support.google.com/admanager/answer/11204312. Accessed May 23, 2024.
[449] Google's First Amended Responses and Objections to Plaintiff's Third Set of Interrogatories, (May 24, 2024) at 11. Cox, S., "Announcing Exchange Bidding open beta," (June 8, 2017) https://blog.google/products/admanager/announcing-exchange-bidding-open-beta/. Accessed May 23, 2024.
[450] Google, "How we decide which ad is served," https://support.google.com/admanager/answer/11204312. Accessed May 23, 2024.
[451] Google, "How we decide which ad is served," https://support.google.com/admanager/answer/11204312. Accessed May 23, 2024; Google, "How Open Bidding works," https://support.google.com/admanager/answer/7128958. Accessed May 24, 2024.
[452] [redacted] Deposition, (May 2, 2024) at 77:11-13.

A. Header Bidding solicits demand across multiple supply-side platforms and resolves technical challenges of waterfall auctions

160. As discussed in Section VI.A, ad auctions were originally conducted using a "waterfall" approach, a publisher's line items for an impression would be sequentially passed from demand source (*i.e.*, demand-side platforms, ad networks, and ad exchanges) to demand source until the ad server received satisfactory bids for the impression.[453] The sequential order of the demand sources was determined using factors such as average historic performance for the publisher or a pre-negotiated price with the demand source: in other words, demand sources that produced better bids for publishers were placed earlier in the waterfall.[454] However, also discussed in Section VI.A, waterfall auctions came with several technical drawbacks, such as potential latency issues.[455] Figure 18 below depicts the waterfall auction process.

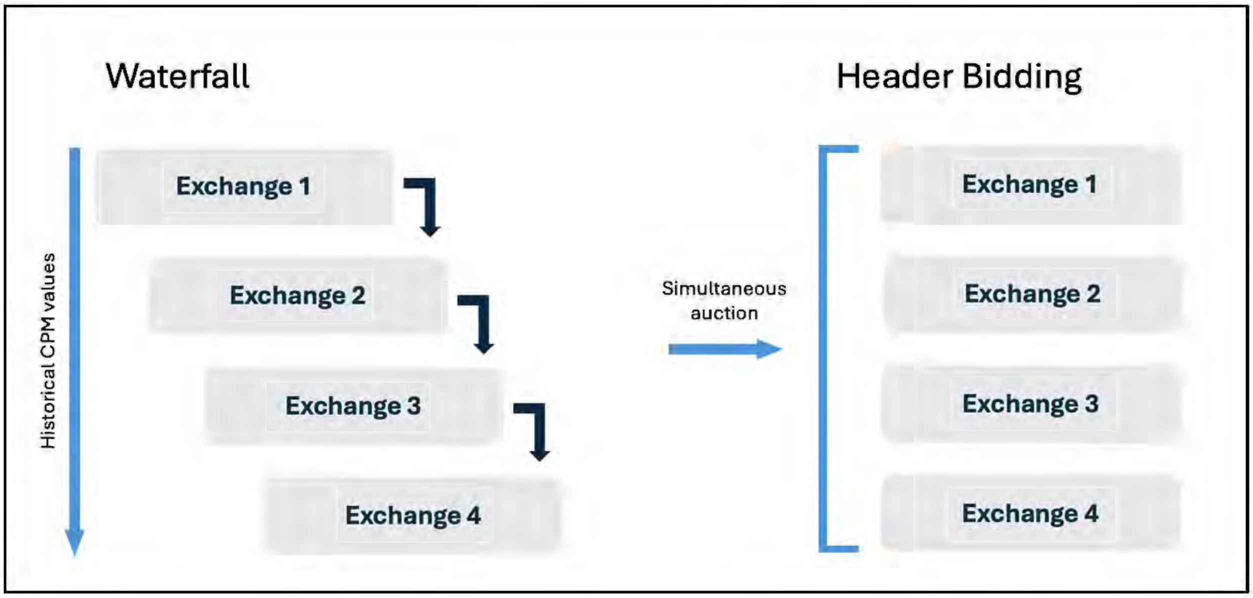
Figure 18: Waterfall auction process[456]



453 Google internal document, "Mediation and Exchange Bidding in DRX," (October 18, 2017) GOOG-AT-MDL-001110980 at '981 (CI); Google internal document, "Clearing Up Misconceptions About Google's Ad Tech Business," (May 5, 2020) GOOG-NE-10780865 at '878-879 (HCI).
454 Google internal document, "Clearing Up Misconceptions About Google's Ad Tech Business," (May 5, 2020) GOOG-NE-10780865 at '878-879 (HCI); Google internal document, "Mediation and Exchange Bidding in DRX," (October 18, 2017) GOOG-AT-MDL-001110980 at '982 (CI).
455 [redacted] Deposition, (April 26, 2024) at 107:17-24.
456 Google internal document, "Ad Manager Ecosystem 101," GOOG-AT-MDL-001004706 at '731 (HCI).

161. The introduction of Header Bidding in 2014 helped resolve the technical challenges of waterfall auctions.[457] Instead of passing through ad networks or exchanges one-by-one, Header Bidding allows demand sources to simultaneously bid on an impression before the impression is sold from the publisher's ad server.[458] Because all demand sources participating in Header Bidding bid in real-time, the ad server would be able to select the winner based on the highest bid, instead of the buyers' historical performances. Figure 19 below shows how Header Bidding enabled buyers to bid in parallel.

Figure 19: Sequential waterfall auctions compared to parallel Header Bidding auctions[459]



162. Prior to 2019, the only exceptions to parallel bidding were AdX and third-party buyers that were allowed to bid into AdX. This is because, as discussed in B, the winning Header Bidding bid that was sent to DFP was used to inform the floor price of the AdX auction due to Last Look, before the AdX auction even occurred. From 2019 onwards, Header Bidding could compete in real-time with AdX in a unified auction, as discussed in Sections VII.C.

457 "I started calling it Header Bidding in 2014 — right from the beginning." Digiday, "'An ad tech urban legend': An oral history of how Header Bidding became digital advertising's hottest buzzword," (June 16, 2017) https://digiday.com/media/header-bidding-oral-history/. Accessed May 23, 2024. "I think that what led to the creation of Header Bidding was this innovation of auction of auctions. And based on the way that the ad server was built, Header Bidding was a crude way to be able to support an auction of auctions." [redacted] Deposition, (April 26, 2024) at 104:1-7.

458 Google internal document, "Exchange Bidding Training," (August 2019) GOOG-TEX-00971841 at '845-846 (HCI).

459 Google internal document, "Mediation and Exchange Bidding in DRX," (October 18, 2017) GOOG-AT-MDL-001110980 at '993 (CI).

163. For publishers using Google Ad Manager (GAM), Header Bidding allowed publishers to get more precise yields from third-party exchanges and networks. This was because prior to Header Bidding, only AdX demand sources were able to compete with real-time CPMs in an AdX auction, as discussed in Section VI.[460] With Header Bidding, real bids from third-party exchanges and networks could compete with AdX for inventory. The difference between the estimated CPM and the real-time CPM could be substantial, so Header Bidding helped publishers get more accurate bids.[461]

164. The next section will discuss Header Bidding's technical implementation in greater detail.

B. Header Bidding is implemented as code in a publisher's own webpage

165. Publishers implement Header Bidding by inserting code into their own webpages. Rather than write their own proprietary code to manage different demand sources, evaluate bids, and communicate with ad servers, publishers implement Header Bidding using packaged code known as "wrappers" or "frameworks" from third-party providers.[462] An example of a Header Bidding wrapper provider is Prebid, a widely used, free, and open-source Header Bidding software product.[463] The following sections further discuss how Header Bidding is implemented for a webpage.

a) HTML, CSS, and JavaScript are the building blocks of a webpage

166. Publishers insert the Header Bidding wrapper into the code that represents the publisher's webpage. To understand how this is done, consider the construction of a webpage. Webpages are generally constructed with code written in three languages: HTML, CSS, and JavaScript.

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[460] Google internal document, "PRD: Real-time YM with Header Container," GOOG-AT-MDL-008236563 at '563, '566 (CI).
[461] "One of the core values of DRX has been the real-time nature of AdX competing with both direct and remnant line items. In contrast other demand sources, such as buyers and exchanges, instead compete using an average value. The difference between the average CPM and the real-time value of a query/cookie could be additional yield. With publishers constantly looking for incremental yield, the potential uplift from real-time pricing has been quite attractive." Google internal document, "PRD: Real-time YM with Header Container," GOOG-AT-MDL-008236563 at '563, '566 (CI).
[462] Zaiceva, A., Setupad, "Header Bidding vs Waterfall | Differences Explained," (July 13, 2021) https://setupad.com/blog/header-bidding-vs-waterfall/. Accessed May 23, 2024.
[463] Prebid, "Introduction to Prebid," https://docs.prebid.org/overview/intro.html. Accessed May 23, 2024.

167. HTML is the standard markup language used for displaying documents such as webpages in a web browser and defines the structure of the webpage's content.[464] HTML uses various elements called tags to structure content. Some examples of HTML tags include:[465]

1) `head` tag: Contains metadata about the webpage, such as the webpage's title, scripts, and styling.

2) `body` tag: Contains the content of the webpage, such as text or images.

3) `header` tag: Contains introductory and navigational content for a webpage, such as logos, titles, or navigational links.

4) `script` tag: Contains executable code that is run when the browser processes the tag.

5) `div` tag: A generic tag used to organize pieces of content.

6) `p` tag: Contains a paragraph, which in the context of HTML, refers to any structural grouping of related content, such as images.

168. CSS is a language that visually styles HTML elements.[466] For example, CSS code can change the font size and color of a paragraph of text or specify the location on the webpage for an image or other piece of content. CSS code does this by specifying an HTML tag, properties of that tag, and the values for each property. For example, for an HTML `p` tag enclosing a paragraph of text, the CSS code file might specify the color and paragraph width as properties and set the paragraph's color to red and width to 500 pixels.

169. JavaScript is a programming language that can be used to add interactivity to a website, such as games, animated graphics, or applications.[467] JavaScript is widely used, and developers often create third-party frameworks, libraries, and application programming interfaces (APIs) for other developers to use to add specialized functionalities to their webpages. JavaScript code can

[464] Mozilla, "HTML basics," https://developer.mozilla.org/en-US/docs/Learn/Getting_started_with_the_web/HTML_basics. Accessed May 23, 2024.
[465] Mozilla, "HTML elements reference," https://developer.mozilla.org/en-US/docs/Web/HTML/Element. Accessed May 23, 2024.
[466] Mozilla, "CSS basics," https://developer.mozilla.org/en-US/docs/Learn/Getting_started_with_the_web/CSS_basics. Accessed May 23, 2024.
[467] Mozilla, "JavaScript basics," https://developer.mozilla.org/en-US/docs/Learn/Getting_started_with_the_web/JavaScript_basics. Accessed May 23, 2024.

be integrated into a webpage's HTML code using the `script` tag. The `script` tag contains executable code stored in a separate JavaScript code file, or the executable code can be written into the HTML file itself.[468]

170. When a browser loads the webpage, it reads a file containing HTML code defining the structure of the webpage and any associated CSS and JavaScript code from top to bottom and executes any JavaScript code in that order.[469] Thus, the HTML file also communicates the order in which JavaScript code should be executed.

b) Header Bidding is implemented as JavaScript code included in the HTML of a webpage

171. Header Bidding wrappers are JavaScript code libraries that run in the browser.[470] Consider a basic example by Prebid that provides the HTML for a webpage that uses the Header Bidding wrapper Prebid.js and integrates with Google Ad Manager (GAM) ad slots.[471] A portion of this code is shown in Figure 20 below.

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[468] "Used to embed executable code or data; this is typically used to embed or refer to JavaScript code." Mozilla, "HTML elements reference," https://developer.mozilla.org/en-US/docs/Web/HTML/Element. Accessed May 23, 2024.

[469] "The reason the instructions (above) place the <script> element near the bottom of the HTML file is that the browser reads code in the order it appears in the file. If the JavaScript loads first and it is supposed to affect the HTML that hasn't loaded yet, there could be problems. Placing JavaScript near the bottom of an HTML page is one way to accommodate this dependency." Mozilla, "JavaScript basics," https://developer.mozilla.org/en-US/docs/Learn/Getting_started_with_the_web/JavaScript_basics. Accessed May 23, 2024.

[470] "Prebid.js is a JavaScript library that runs in the browser, and is the core product of the Prebid suite. It supports multiple formats including display, video, and native, and provides a simple process for Header Bidding that can be ramped up to fit the complexity of your needs." Prebid, "Introduction to Prebid," https://docs.prebid.org/overview/intro.html. Accessed May 23, 2024.

[471] Prebid, "Basic Prebid.js Example," https://docs.prebid.org/dev-docs/examples/basic-example.html. Accessed May 23, 2024.

Figure 20: Webpage code for loading Prebid.js and GPT libraries and defining ad units[472]

```
<link rel="icon" type="image/png" href="/favicon.png">
<script async src="//www.googletagservices.com/tag/js/gpt.js"></script>
<script async src="//cdn.jsdelivr.net/npm/prebid.js@latest/dist/not-for-prod/prebid.js"></script>
<script>
    var div_1_sizes = [
        [300, 250],
        [300, 600]
    ];
    var div_2_sizes = [
        [728, 90],
        [970, 250]
    ];
    var PREBID_TIMEOUT = 1000;
    var FAILSAFE_TIMEOUT = 3000;

    var adUnits = [
        {
            code: '/19968336/header-bid-tag-0',
            mediaTypes: {
                banner: {
                    sizes: div_1_sizes
                }
            },
            bids: [{
                bidder: 'appnexus',
                params: {
                    placementId: 13144370
                }
            }]
        },
```

172. At the beginning of the webpage HTML, the code `<script async src="//cdn.jsdelivr.net/npm/prebid.js@latest/dist/not-for-prod/prebid.js"></script>` adds a file containing the Prebid.js Header Bidding module to the webpage. Similarly, the code `<script async src="//www.googletagservices.com/tag/js/gpt.js"></script>` tells the browser to add a file containing code for Google Publisher Tag (GPT).[473]

173. Farther down the page, the JavaScript code defines a variable `adUnits` which specifies the ad units available on the webpage, as well as the demand sources that are allowed to bid on each

[472] Prebid, "Basic Prebid.js Example," https://docs.prebid.org/dev-docs/examples/basic-example.html. Accessed May 23, 2024.
[473] Google, "Overview of Google Publisher Tag," https://support.google.com/admanager/answer/181073. Accessed May 30, 2024.

unit. In the example below, `adUnits` specifies two ad slots[474] and allows a single demand source, AppNexus, to bid on each slot.[475] If the publisher wished to add more demand sources, such as Rubicon or Criteo, to bid on the ad unit, they would simply add another item to the bids list containing the names of allowed bidders.[476] This demonstrates the simplicity of using a third-party Header Bidding wrapper.

174. The webpage's code then tells the browser to request Header Bidding bids and then send an ad request to the ad server, such as GAM.[477] A portion of this code is shown in Figure 21 below.

[474] Prebid, "Basic Prebid.js Example," https://docs.prebid.org/dev-docs/examples/basic-example.html. Accessed May 23, 2024.
[475] Prebid, "Basic Prebid.js Example," https://docs.prebid.org/dev-docs/examples/basic-example.html. Accessed May 23, 2024.
[476] Prebid, "Ad Unit Reference," https://docs.prebid.org/dev-docs/adunit-reference.html. Accessed May 23, 2024.
[477] Note that this figure only shows one ad slot. The full Prebid.js example code has two. Prebid, "Basic Prebid.js Example," https://docs.prebid.org/dev-docs/examples/basic-example.html. Accessed May 23, 2024.

Figure 21: Webpage code for Header Bidding bid requests and GAM ad request[478]

```
var googletag = googletag || {};
googletag.cmd = googletag.cmd || [];
googletag.cmd.push(function() {
    googletag.pubads().disableInitialLoad();
});

var pbjs = pbjs || {};
pbjs.que = pbjs.que || [];

pbjs.que.push(function() {
    pbjs.addAdUnits(adUnits);
    pbjs.requestBids({
        bidsBackHandler: initAdserver,
        timeout: PREBID_TIMEOUT
    });
});

function initAdserver() {
    if (pbjs.initAdserverSet) return;
    pbjs.initAdserverSet = true;
    googletag.cmd.push(function() {
        pbjs.que.push(function() {
            pbjs.setTargetingForGPTAsync();
            googletag.pubads().refresh();
        });
    });
}

setTimeout(function() {
    initAdserver();
}, FAILSAFE_TIMEOUT);

googletag.cmd.push(function() {
    googletag.defineSlot('/19968336/header-bid-tag-0', div_1_sizes, 'div-1').addService(googletag.pubads());
    googletag.pubads().enableSingleRequest();
    googletag.enableServices();
});
```

175. First, automatic requesting and rendering of ad content from GAM is disabled using `googletag.pubads().disableInitialLoad()`,[479] which lets the browser make callouts to third-party exchanges and DSPs *before* calling the ad server. The ad units stored in `adUnits` are added to the Prebid auction using `pbjs.addAdUnits(adUnits)`, which, in turn, requests bids using `pbjs.requestBids()`.[480] Each Header Bidding demand source runs an auction of its own and returns a "bid response" for the highest bid, which includes the bidder name and ad ID, the

[478] Prebid, "Basic Prebid.js Example," https://docs.prebid.org/dev-docs/examples/basic-example.html. Accessed May 23, 2024.
[479] "The automatic requesting and rendering of ad content can be disabled via the PubAdsService.disableInitialLoad() method." Google, "Control ad loading and refresh," https://developers.google.com/publisher-tag/guides/control-ad-loading. Accessed May 23, 2024.
[480] Prebid, "pbjs.addAdUnits(Array|Object)," https://docs.prebid.org/dev-docs/publisher-api-reference/addAdUnits.html. Accessed May 23, 2024; Prebid, "pbjs.requestBids(requestObj)," https://docs.prebid.org/dev-docs/publisher-api-reference/requestBids.html. Accessed May 23, 2024.

width and height of the ad, and the exact CPM of the bid or the CPM rounded to a price bucket (*e.g.*, at "low granularity" price buckets in increments of $0.50, a $1.61 bid is floored to a $1.50 price bucket instead of a $2.00 price bucket).[481] Outside of Prebid, Header Bidding demand sources can also return other responses besides the CPM of the highest bid. For example, the demand source may return a CPM range instead of a value, such as the range $1.50-2.00. The demand source may also return a "Yes/No" indicator representing whether the demand source has a satisfactory bid to return.[482]

176. Once Prebid.js has received all bids or the request times out (because no demand source returned a response within a predefined period of time), and once GPT has registered all ad slots to be sent to GAM, the function `initAdserver()` is invoked. This function calls `pbjs.setTargetingForGPTAsync()` to match ad units returned from the auction to a GPT ad slot and adds Header Bidding targeting attributes corresponding to a line item (*e.g.*, the winning bid, winning bidder, ad size, and ad format) to the ad slot so they are sent to GAM.[483] `initAdserver()` then uses `googletag.pubads().refresh()` to send a request to GAM to populate the ad slots with ad content and display the ads.[484] GAM then processes the ad request to run an auction in AdX and serve the winning ad, as discussed below in Section C.

177. Figure 22 below shows the webpage with all visual elements and advertisements loaded. Note that the top ad slot displays a House ad from Prebid because the Header Bidding request for that ad slot timed out. The bottom ad slot shows an ad delivered from a Header Bidding buyer.

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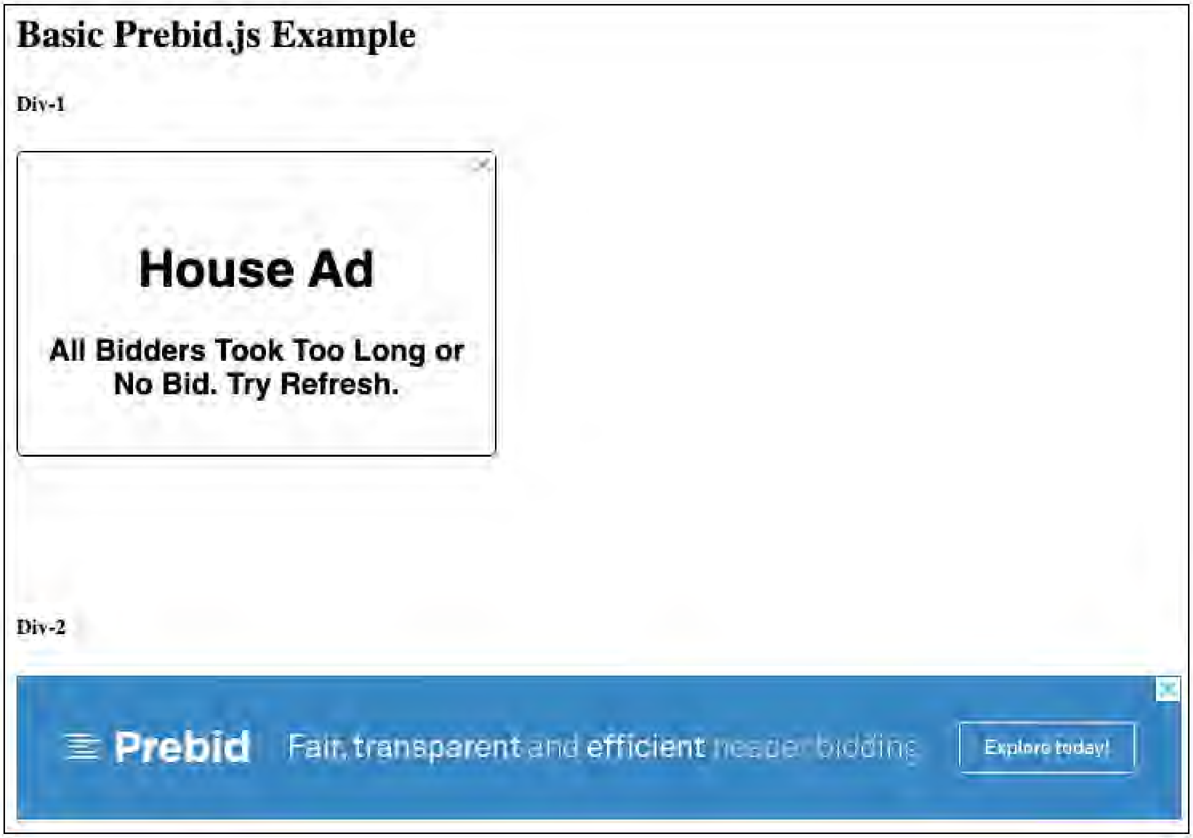
[481] Prebid, "Troubleshooting Prebid.js," . Accessed May 23, 2024; Prebid, "pbjs.getBidResponses()," https://docs.prebid.org/dev-docs/publisher-api-reference/getBidResponses.html. Accessed May 23, 2024.
[482] Google internal document, "Header Bidding T1 Impact," GOOG-NE-04427230 at '239 (HCI).
[483] Prebid, "pbjs.setTargetingForGPTAsync([codeArr], customSlotMatching)," https://docs.prebid.org/dev-docs/publisher-api-reference/setTargetingForGPTAsync.html. Accessed May 23, 2024; Prebid, "Key Values," https://docs.prebid.org/adops/key-values.html. Accessed May 23, 2024.
[484] "The PubAdsService.refresh() method is used to populate a slot or slots with new ad content. This method can be used on slots that have yet to load any content (due to disableInitialLoad()), or to replace the contents of an already populated slot." Google, "Control ad loading and refresh," https://developers.google.com/publisher-tag/guides/control-ad-loading. Accessed May 23, 2024.

Figure 22: Prebid.js basic example after loading the webpage[485]



178. In summary, the Prebid example implements Header Bidding as JavaScript code in a webpage, and the Header Bidding auction runs before a request is sent to the publisher's ad sever. To accomplish this, a webpage implementing Header Bidding first pauses requests to the publisher's ad server. Afterwards, code from the Header Bidding wrapper requests bids from other demand sources first, runs an auction to determine the winning bid, and adds the winning bid, winning bidder, and other information to the ad slot, so the results of Header Bidding are sent to the publisher's ad server. Finally, a request to the publisher's ad server is sent to populate the ad slots.

C. Google uses the results of Header Bidding as inputs into the ad serving process

179. As the Prebid example shows, for publishers using GAM the results of Header Bidding are sent to the DFP ad server, which sits within GAM, along with the publisher's request for an ad.

[485] Prebid, "Basic Prebid.js Example," https://docs.prebid.org/dev-docs/examples/basic-example.html. Accessed May 23, 2024.

Specifically, the browser passes data from Prebid in the form of "key-value pairs," which are essentially the names of variables paired with their associated values.[486]

180. Key-value pairs were an existing feature in Google's ad stack that allowed publishers to define custom targeting for line items.[487] Key-value pairs were originally designed to pass in targeting criteria such as age, gender, and page content and were not designed specifically to accommodate Header Bidding.[488] Header Bidding took advantage of Google's key-value pair feature to pass in targeting criteria such as the winning bid and bidder; this is the "core" of how Header Bidding technologies like Prebid communicate with DFP.[489] For example, Prebid may send to DFP a key-value pair (`hb_pb: 2.10`), where `hb_pb` is the bid "price bucket," which indicates that a Header Bidding bid was $2.10, and (`hb_bidder: "appnexus"`), where `hb_bidder` indicates that Header Bidding bid was submitted from AppNexus.[490]

181. The Header Bidding bids usually correspond to remnant line items in GAM (*e.g.*, Price Priority),[491] though a small portion of Header Bidding bids are mapped to Standard or Sponsorship line items.[492,493] When Header Bidding bids are mapped to Standard or Sponsorship line items, AdX will not always compete because a backfill call may not be sent to AdX for guaranteed line items as discussed in Sections VI and VII.[494]

182. As part of setting up Header Bidding and integrating it with GAM, publishers create line items in GAM.[495] Publishers populate these line items with target key-value pairs from Header

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486 Prebid, "Key Values," https://docs.prebid.org/adops/key-values.html. Accessed May 23, 2024.
487 Google internal document, "Exchange Bidding Training," (August 2019) GOOG-TEX-00971841 at '845 (HCI).
488 Google, "Get started with key-values," https://support.google.com/admanager/answer/188092. Accessed May 30, 2024.
489 "Prebid uses key-value pairs to pass bid information to the ad server. This puts key values at the core of how Prebid works. Without key values, Prebid would have no way of communicating with ad servers, and therefore no way to make Header Bidding part of the auction." Prebid, "Key Values," https://docs.prebid.org/adops/key-values.html. Accessed May 23, 2024.
490 Prebid, "Key Values," https://docs.prebid.org/adops/key-values.html. Accessed May 23, 2024.
491 See Appendix C Section B.12 for findings from my analysis of Google's source code on the implementation of Header Bidding bids.
492 Google internal document, "Data-driven optimisations for Ad Manager," (October 2020) GOOG-AT-MDL-000009165 at '201 (CI); Google internal document, "Header Bidding & AdX Positioning," (December 2, 2015) GOOG-AT-MDL-004284449 at '461 (CI); Google internal document, "Header Bidding Observatory #2," (May 2017) GOOG-TEX-00971726 at '744 (HCI).
493 See Appendix C Section B.13 for findings from my analysis of Google's source code on the transaction type of Header Bidding line items.
494 Google internal document, "Header Bidding & AdX Positioning," (December 2, 2015) GOOG-AT-MDL-004284449 at '461 (CI).
495 Google internal document, "Exchange Bidding Training," (August 2019) GOOG-TEX-00971841 at '845 (HCI).

Bidding, such as `hb_pb`, `hb_bidder`, `hb_size`, and `hb_format` from Prebid.[496] For example, a particular line item might have target key-value pairs (`hb_pb: 10.50`) and (`hb_bidder: "appnexus"`). When the code on the publisher's webpage makes an ad request to GAM, it passes the Header Bidding bid key-value pairs.[497] GAM will select the most appropriate line item by comparing the key-value pairs from Header Bidding to the target key-value pairs contained in the line item, and selecting the best match.[498]

183. For instance, consider a simple example where the only key-value pairs considered are the Header Bidding bid amount, represented as `hb_pb`. Here, the publisher has configured two line items: Line Item 1 with target key-value pair (`hb_pb: 10.50`) and Line Item 2 with target key-value pair (`hb_pb: 10.00`). If the Header Bidding bid is $10.50 then GAM will match the bid to Line Item 1, and if the Header Bidding bid is $10.00 then GAM will match the bid to Line Item 2. The selected line item would then compete in the AdX auction using the line item's CPM.

184. In practice, the publisher needs to create a line item for every bid price that could be received from Header Bidding buyers, so GAM can match the Header Bidding bids to the best line items.[499] Because the number of possible bid prices is enormous, the publisher faces a tradeoff when creating line items. A publisher creating more line items can specify prices at a greater granularity, and publishers could better capture the true value of bids from Header Bidding. For example, if the publisher created line items in $0.10 increments, a $10.44 bid from Header Bidding might be matched to a line item with a $10.40 CPM; in contrast, if the publisher created line items in $0.50 increments, then the same bid might be matched to a line item with a $10.00 CPM. However, because creating line items in GAM is a manual process, managing many line items for Header Bidding can be very labor-intensive, with publisher potentially creating thousands of line items for a single Header Bidding buyer.[500] Conversely, a setup with fewer line

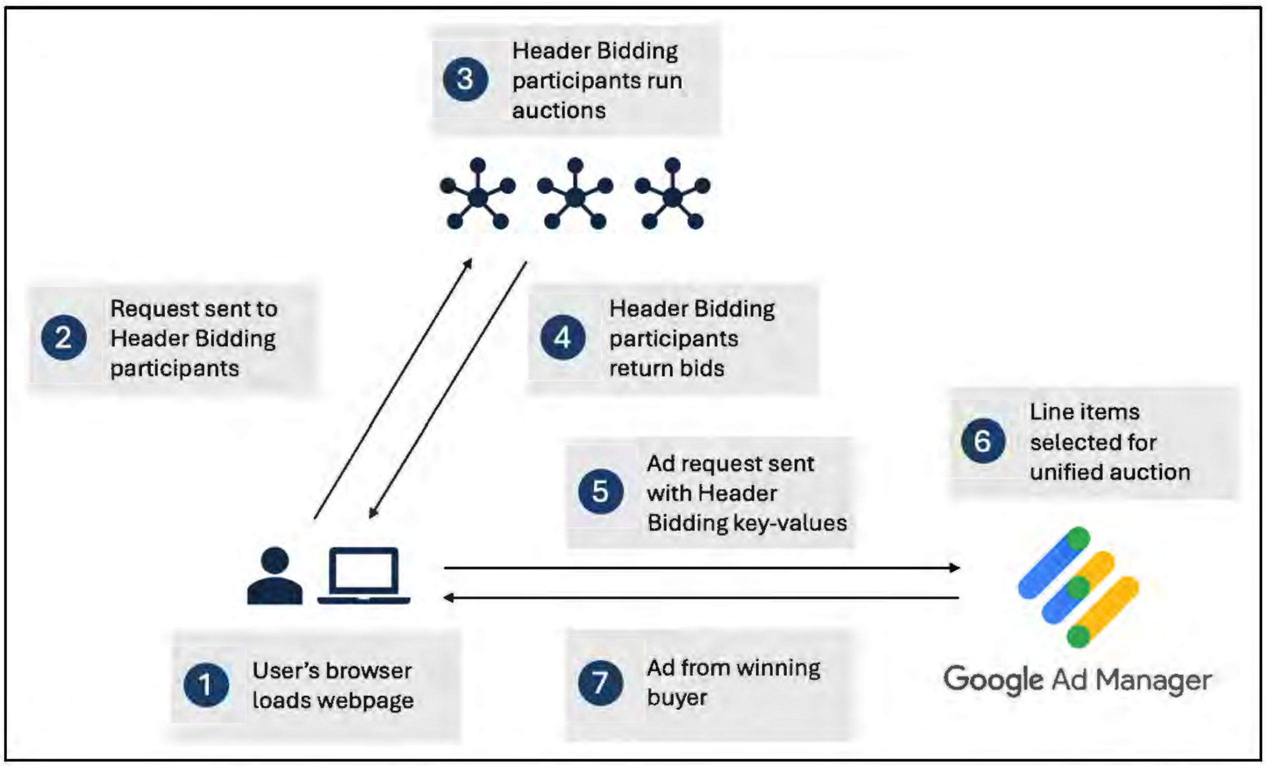
[496] "When you create your line item, you'll be targeting key-value pairs that are being sent with the ad request to the ad server. Any keys you target need to be defined in GAM before you can use them in your line items." Prebid, "Key Values," https://docs.prebid.org/adops/key-values.html. Accessed May 23, 2024.
[497] Google internal document, "Exchange Bidding Training," (August 2019) GOOG-TEX-00971841 at '845 (HCI); Prebid, "Key Values," https://docs.prebid.org/adops/key-values.html. Accessed May 23, 2024.
[498] Google internal document, "When the game changes: How HB affects Yield management in DRX," GOOG-AT-MDL-000993446 at '458, '478 (CI).
[499] Prebid, "Price Granularity," https://docs.prebid.org/adops/price-granularity.html. Accessed June 4, 2024.
[500] Prebid, "Price Granularity," https://docs.prebid.org/adops/price-granularity.html. Accessed June 4, 2024; Google, "Add new line items," https://support.google.com/admanager/answer/82236?hl=en. Accessed June 4, 2024.

items means less labor and effort for the publisher, but the publisher would be specifying prices at a lesser granularity and therefore could lose money on the Header Bidding bids they receive.[501]

185. If a Header Bidding bid is the winner of the auction for an impression, GAM will return a third-party buyer tag back to the browser.[502] This third-party buyer tag is not the ad itself to be ultimately displayed on the browser, but instead represents a request to a third-party ad server that serves the Header Bidding buyer and stores the ad to be displayed.[503] When the third-party buyer tag is executed by the browser, it requests the ad to be displayed from the third-party ad server.[504]

186. Figure 23 below shows the Header Bidding workflow from start to finish.

Figure 23: Header Bidding workflow with GAM



501 Prebid, "Price Granularity," https://docs.prebid.org/adops/price-granularity.html. Accessed June 4, 2024.
502 Google internal document, "Header Bidding T1 Impact," GOOG-NE-04427230 at '239 (HCI).
503 Google internal document, "Exchange Bidding Training," (August 2019) GOOG-TEX-00971841 at '846 (HCI); Google, "Third-party ad serving (3PAS)," https://support.google.com/authorizedbuyers/answer/2961247. Accessed May 23, 2024.
504 Google internal document, "Header Bidding T1 Impact," GOOG-NE-04427230 at '239 (HCI).

187. The discussion above shows how GAM can take the results of Header Bidding as input to the unified auction. Note that AdX did not directly participate in Header Bidding as a demand source. For publishers that did not use AdX, this meant that even with Header Bidding there was no way they could access demand sources that only bid into AdX, such as Google Ads.[505] Thus, publishers that did not use GAM and AdX had a more limited set of demand sources.

188. In conclusion, Header Bidding is a technology that enables publishers to solicit demand for impressions outside of the publisher's ad server, such as DFP within GAM. Client-side Header Bidding is implemented as JavaScript code that is run by the user's browser when it loads a webpage and gathers bids from external demand sources before a request is sent to the publisher's ad server. The publisher's ad server accounts for the results of Header Bidding in the server's own auction, and Header Bidding is treated as a line item among many other line items.

D. Different types of Header Bidding implementations are used, each with their own benefits and drawbacks

189. Publishers may set up Header Bidding in different ways. There are two main ways to set up Header Bidding: client-side and server-side. This section gives an overview of client-side and server-side Header Bidding, as well as their benefits and drawbacks.

190. Client-side Header Bidding is the most popular version of Header Bidding; it is based in the user's browser and works like a tag in a webpage's header.[506] Client-side Header Bidding proceeds in four steps:[507]

1) When the browser loads a webpage, the browser runs the JavaScript code for Header Bidding.

[505] "Google Ads, formerly AdWords, internally known as Google Display Ads (GDA) is our basic buy-side product, allowing advertisers to buy ads through Google ... These ads are stored in Adgroup Server (AGS) and are served by many Google ad serving stacks." Google internal document, "AViD Serving Infrastructure 101 (Backend)," (December 18, 2023) GOOG-AT-MDL-B-005180695 at '698 (HCI).
[506] "Client-side Header Bidding remains the most popular version of the technology, and operates similarly to any tag you might find in a website's header." Taylor, R., Criteo, "Header Bidding Demystified: Client-Side vs. Server-Side," (June 13, 2022) https://www.criteo.com/blog/header-bidding-demystified-client-side-vs-server-side/. Accessed May 23, 2024.
[507] Google internal document, "Header Bidding Observatory #2," (May 2017) GOOG-AT-MDL-004300268 at '274 (CI); Taylor, R., Criteo, "Header Bidding Demystified: Client-Side vs. Server-Side," (June 13, 2022) https://www.criteo.com/blog/header-bidding-demystified-client-side-vs-server-side/. Accessed May 23, 2024.

2) The JavaScript code sends a request for bids from multiple demand sources simultaneously. Each demand source has a certain amount of time to respond with a bid before the request times out.

3) The Header Bidding JavaScript code passes information on the Header Bidding auction bids to the publisher's ad server, such as GAM. For some Header Bidding wrappers like Prebid, the publisher can specify whether they send only the winning bid or all bids.[508]

191. The publisher's ad server sends bid requests to additional demand sources through exchanges (*e.g.*, AdX), which run auctions of their own, and decides on the ad to be loaded onto the webpage, while accounting for the information from Header Bidding.

192. Based on this description, the Prebid.js implementation discussed in Section VIII.B is an example of client-side Header Bidding. Key advantages of client-side Header Bidding include the ability to specify exactly which demand sources to include and simple scalability with more demand sources:[509] as the Prebid.js example shows, adding a demand source is as simple as writing a few extra lines of code in the webpage. The Prebid.js example also shows that client-side Header Bidding requires few installation steps: the publisher simply downloads the software and selects the desired demand sources.[510] Additionally, because the entire process occurs in the user's browser, demand sources can read browser cookies to identify the user and adjust their bids to fit the user's profile.[511]

193. However, browsers such as Mozilla Firefox, Apple Safari, Brave Browser, and Google Chrome have recently begun restricting the usage of third-party cookies, which build user profiles by tracking user activity across websites; this reduces client-side Header Bidding's ability to identify users.[512]

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[508] "When you're sending the Top Price Bid to the ad server, the preceding keys are the only keys that will be sent. If you're Sending All Bids, the preceding keys will be sent, plus the same set of keys specific to each bidder, with the bidder name appended." Prebid, "Key Values," https://docs.prebid.org/adops/key-values.html. Accessed May 23, 2024.
[509] "[Pros of client-side Header Bidding:] Easier to add multiple SSPs after the first[.]" Google internal document, "Header Bidding Observatory #2," (May 2017) GOOG-AT-MDL-004300268 at '274 (CI).
[510] "To run heading [*sic*] bidding on your site with Prebid.js you need to download the Prebid.js package, including your selected bidders and adapters, and add the code to your page." Prebid, "Getting Started for Developers," https://docs.prebid.org/dev-docs/getting-started.html. Accessed May 24, 2024.
[511] "Better identity resolution thanks to the ability to use browser-based cookie syncing." Taylor, R., Criteo, "Header Bidding Demystified: Client-Side vs. Server-Side," (June 13, 2022) https://www.criteo.com/blog/header-bidding-demystified-client-side-vs-server-side/. Accessed May 23, 2024.
[512] Mills, C., Mozilla, "Saying goodbye to third-party cookies in 2024," (December 7, 2023) https://developer.mozilla.org/en-US/blog/goodbye-third-party-cookies/. Accessed May 24, 2024.

194. Additionally, because the browser handles multiple calls to demand sources and runs the Header Bidding auction, client-side Header Bidding may affect webpage loading latency.[513] Even so, this latency can be reduced or eliminated with mitigations such as using more modern networking protocols or optimizing third-party exchanges' auction code.[514]

195. The extent to which client-side Header Bidding impacts latency can also vary. For example, in 2017, Google conducted a study on the effect of client-side Header Bidding on latency by comparing versions of a publisher's webpage without using client-side Header Bidding to versions with client-side Header Bidding enabled.[515] However, Google found that the versions without client-side Header Bidding actually experienced higher latency than the versions with client-side Header Bidding and attributed a significant portion of page load times to the GPT tag.[516] This showed that client-side Header Bidding is just one of several factors that can affect webpage loading latency and may not always be the main factor.

196. An alternative to client-side Header Bidding is server-side Header Bidding. Unlike in client-side Header Bidding where the browser is responsible for managing the calls to demand sources and running the auction, in server-side Header Bidding the browser calls an external server to manage the process.[517] This allows the browser to focus on serving content, instead of having to spend additional time and resources on the Header Bidding process. Examples of server-side Header Bidding include Prebid Server (a separate product from the Prebid.js wrapper) and Amazon Transparent Ad Marketplace.[518]

197. The process of setting up server-side Header Bidding can be more complicated relative to client-side Header Bidding, because an external server needs to be hosted and managed. For

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513 "[Cons of client-side Header Bidding:] Prone to higher levels of latency and impacted user experience[.]" Google internal document, "Header Bidding Observatory #2," (May 2017) GOOG-AT-MDL-004300268 at '274 (CI); [redacted] Deposition (April 26, 2024) at 107:17-24.
514 Aqeel, W., Bhattacherjee, D., et al., "Untangling Header Bidding Lore: Some Myths, Some Truths, and Some Hope," In: Sperotto, A., Dainotti, A., Stiller, B. (eds) Passive and Active Measurement. PAM 2020. Lecture Notes in Computer Science, vol 12048. Springer, Cham. https://doi.org/10.1007/978-3-030-44081-7_17.
515 Google internal email, "Re: EB/ HB latency study - need two more pubs," (May 5, 2017) GOOG-DOJ-14739278 at '281 (HCI).
516 Google internal email, "Re: Catchpoint - MailOnline URL endpoints," (February 13, 2018) GOOG-DOJ-14744242 at '252 (HCI).
517 Google internal document, "Header Bidding Observatory #2," (May 2017) GOOG-AT-MDL-004300268 at '274 (CI); Taylor, R., Criteo, "Header Bidding Demystified: Client-Side vs. Server-Side," (June 13, 2022) https://www.criteo.com/blog/header-bidding-demystified-client-side-vs-server-side/. Accessed May 23, 2024.
518 Prebid, "Prebid Server Overview," https://docs.prebid.org/prebid-server/overview/prebid-server-overview.html. Accessed May 24, 2024; Amazon, "Transparent Ad Marketplace," https://aps.amazon.com/aps/transparent-ad-marketplace/. Accessed May 23, 2024.

example, Prebid states that "installing [Prebid Server] is not nearly as easy as Prebid.js."[519] This is in large part because hosting an external server requires significant infrastructure, including the server itself, databases and replicas of databases, monitoring systems, load balancers to route requests, and the server-side software.[520] Prebid Server also partners with third-party managed service providers that host the external servers rather than having the publisher set up and manage their own in-house infrastructure; this is still an installation step that is not required for the client-side Prebid.js.[521]

198. The overall process of server-side Header Bidding is similar to that of client-side Header Bidding, except that some operations performed by the browser in client-side Header Bidding are delegated to the external server instead. The external server is responsible for sending requests to demand sources and returns the results of the Header Bidding auction to the browser; the browser then sends the winning bid to the publisher's ad server and makes a request for ads.[522]

199. As discussed above, server-side Header Bidding has the advantage of reducing page load latency relative to client-side Header Bidding, since the browser no longer manages calls to the demand sources. Having a server dedicated to calling demand sources also means that server-side Header Bidding can request bids from a larger pool of demand sources.[523] However, because requests to demand sources are left to the server, a publisher using server-side Header Bidding may have less transparency on how the auction is run by the server.[524] Additionally, because the auction is run on servers instead of the browser in server-side Header Bidding, demand sources

[519] Prebid, "Prebid Server Overview," https://docs.prebid.org/prebid-server/overview/prebid-server-overview.html. Accessed May 24, 2024.
[520] Prebid, "Hosting a Prebid Server Cluster," https://docs.prebid.org/prebid-server/hosting/pbs-hosting.html. Accessed May 24, 2024.
[521] "Several Prebid.org members host up-to-date server software with a global footprint, and provide tools to manage stored requests." Prebid, "Prebid Server Overview," https://docs.prebid.org/prebid-server/overview/prebid-server-overview.html. Accessed May 24, 2024.
[522] Google internal document, "Header Bidding Observatory #2," (May 2017) GOOG-AT-MDL-004300268 at '274 (CI); Taylor, R., Criteo, "Header Bidding Demystified: Client-Side vs. Server-Side," (June 13, 2022) https://www.criteo.com/blog/header-bidding-demystified-client-side-vs-server-side/. Accessed May 23, 2024.
[523] Google internal document, "Header Bidding Observatory #2," (May 2017) GOOG-AT-MDL-004300268 at '274 (CI); Taylor, R., Criteo, "Header Bidding Demystified: Client-Side vs. Server-Side," (June 13, 2022) https://www.criteo.com/blog/header-bidding-demystified-client-side-vs-server-side/. Accessed May 23, 2024.
[524] Google internal document, "Header Bidding Observatory #2," (May 2017) GOOG-AT-MDL-004300268 at '274 (CI); Taylor, R., Criteo, "Header Bidding Demystified: Client-Side vs. Server-Side," (June 13, 2022) https://www.criteo.com/blog/header-bidding-demystified-client-side-vs-server-side/. Accessed May 23, 2024.

have limited access to browser cookies for targeting purposes, causing them to "to bid less often or at lower CPMs compared to a client-side integration."[525]

200. Regardless of the implementation chosen, Header Bidding allows publishers to gather additional bids for impressions before sending a request to the ad server and allows third-party demand sources to present real-time CPM bids to compete in auctions, as opposed to average values. This results in more opportunities for publishers to maximize yield on their impressions.

IX. EXCHANGE BIDDING IS GOOGLE'S SERVER-SIDE RESPONSE TO HEADER BIDDING AND ALLOWS THIRD-PARTY EXCHANGES TO COMPETE FOR IMPRESSIONS IN REAL-TIME ALONGSIDE ADX

201. This section covers Exchange Bidding's use cases within the ad serving system, how Exchange Bidding is implemented at a technical level, and how data flows between advertisers and publishers under Exchange Bidding.

A. Google developed Exchange Bidding to rectify technical challenges with waterfall auctions and Header Bidding and to counteract Header Bidding adoption

202. After Header Bidding was introduced, Google tracked its impact and adoption by publishers that worked with Header Bidding providers.[526] Google found that some publishers believed Header Bidding kept Google's own exchange, AdX, "honest and not complacent," and that other publishers wanted Google to provide a Header Bidding solution of their own.[527] Google also saw risks in competitors perceiving Enhanced Dynamic Allocation (EDA) giving AdX an unfair advantage, Header Bidding loosening Google's control over inventory access, namely "guaranteed space,"[528] and existing implementations of Header Bidding being "set up to break EDA resulting in Google not competing in real-time."[529]

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[525] Prebid, "Server-Side Header Bidding with Prebid.js," https://docs.prebid.org/dev-docs/pbsBidAdapter-video-overview.html. Accessed May 24, 2024.
[526] Google internal document, "Header Bidding T1 Impact," GOOG-NE-04427230 at '232 (HCI).
[527] Google internal document, "Header Bidding T1 Impact," GOOG-NE-04427230 at '233, '235 (HCI).
[528] Google internal document, "Exchange Bidding Training," (August 2019) GOOG-TEX-00971841 at '848 (HCI).
[529] Google internal document, "PRD: Real-time YM with Header Container," GOOG-AT-MDL-008236563 at '566 (CI).

203. According to Google, Exchange Bidding aimed to resolve several technical challenges with Header Bidding:[530]

1) Exchange Bidding would eliminate the need for managing complex Header Bidding code on a webpage and numerous Header Bidding line items.

2) Exchange Bidding would allow publishers to get paid faster.

3) Exchange Bidding would make more accurate payments and would centralize reporting.

4) Exchange Bidding would reduce latency and improve user experience.

204. The next section discusses how Exchange Bidding is implemented by Google and how it integrates with the rest of GAM.

B. Exchange Bidding is a server-side solution that runs an auction with both AdX buyers and third-party buyers bidding in real-time

205. Exchange Bidding (also known as "Open Bidding" and internally known as "Jedi") is Google's server-side response to Header Bidding, in which a single bid request is sent from the publisher webpage to the ad server, which then sends bid requests to all participating bidders, including both AdX and third-party exchanges, to compete in a single real-time auction.[531]

206. Exchange Bidding does not require publishers to include specialized code on their webpages, outside of including a GPT tag that publishers would already use to communicate with GAM.[532] However, Exchange Bidding requires several contractual and logistical tasks for both publishers and third-party demand sources. Publishers must sign an addendum to their contract with AdX, create a primary AdX account that is linked to their GAM network and set as the default account for DA, and ensure they have available inventory designated using GPT.[533] Meanwhile, third-party demand sources must sign a contract with Google to participate in Exchange Bidding,

[530] Google internal document, "Data-driven optimizations for Ad Manager," (October 29, 2020) GOOG-AT-MDL-000009165 at '198 (CI).
[531] Google internal document, "[Comms Doc] – Open Bidding on Ad Manager (fka Exchange Bidding)," (August 2019) GOOG-NE-10942712 at '715 (HCI); [redacted] Deposition, (April 26, 2024) at 203:18-204:4, 213:8-16.
[532] "Requests are sent to Ad Manager using Google Publisher Tags." Google, "How Open Bidding works," https://support.google.com/admanager/answer/7128958. Accessed May 24, 2024.
[533] Google internal document, "Mediation and Exchange Bidding in DRX," (October 18, 2017) GOOG-AT-MDL-001110980 at '001 (CI); Google, "Get started with Open Bidding," https://support.google.com/admanager/answer/7128657. Accessed May 30, 2024.

pass a testing period to verify that the Exchange Bidding integration works properly, and obtain contracts with publishers and designate their GAM networks for Exchange Bidding.[534] Google states that this "handshake" ensures the publisher and third-party demand source want to work together.[535]

207. After completing the "handshake," the publisher configures Exchange Bidding directly in GAM. This involves several steps to ensure that the publisher will be able to request bids from the specified third-party demand source during Exchange Bidding:[536]

208. Create yield groups to specify the inventory the publisher wants to sell. Yield groups are treated similarly to AdX line items during auctions in the sense that both yield groups and line items call AdX to run an auction and both trigger Dynamic Allocation.[537] They have targeting that is similar to but less granular than AdX line items: for example, yield groups can support targeting types like geography or browser, but placement targeting is not supported.[538] Additionally, while AdX line items can call many different accounts, yield groups must specify or "map" which AdX and third-party exchanges to call.[539]

1) Create yield partners, which represent the third-party demand sources that compete for the specified yield groups.

2) Configure the yield partners to enable Exchange Bidding integration.

209. After the publisher configures Exchange Bidding in GAM, the publisher can now make ad requests to GAM that incorporate Exchange Bidding. To integrate Exchange Bidding, GAM takes in bids from both AdX and Exchange Bidding demand sources and hosts a "unified auction."

[534] Google internal document, "Mediation and Exchange Bidding in DRX," (October 18, 2017) GOOG-AT-MDL-001110980 at '001 (CI); Google, "Get started with Open Bidding," https://support.google.com/admanager/answer/7128657. Accessed May 30, 2024.
[535] Google internal document, "Mediation and Exchange Bidding in DRX," (October 18, 2017) GOOG-AT-MDL-001110980 at '001 (CI).
[536] Google internal document, "Exchange Bidding Training," (August 2019) GOOG-TEX-00971841 at '864-870 (HCI); Google, "Create and manage yield groups," https://support.google.com/admanager/answer/7390828. Accessed May 23, 2024.
[537] Google internal document, "Exchange Bidding Training," (August 2019) GOOG-TEX-00971841 at '872 (HCI).
[538] Google internal document, "Exchange Bidding Training," (August 2019) GOOG-TEX-00971841 at '872 (HCI); Google, "Create and manage yield groups," https://support.google.com/admanager/answer/7390828. Accessed May 23, 2024; Google, "Targeting types," https://support.google.com/admanager/answer/2884033. Accessed May 24, 2024.
[539] Google internal document, "Exchange Bidding Training," (August 2019) GOOG-TEX-00971841 at '872 (HCI); Google, "How Open Bidding works," https://support.google.com/admanager/answer/7128958. Accessed May 23, 2024.

Google states that all participants in the unified auction compete equally for each impression on a net basis, which accounts for GAM's revenue share.[540] The unified auction process is described below in five steps:[541]

1) The browser loads the publisher's webpage containing a GPT tag, which triggers an ad request that is sent to GAM.

2) GAM uses Enhanced Dynamic Allocation to calculate an auction reserve price. The auction reserve price is sent to all AdX and Exchange Bidding demand sources participating in the auction.[542] EDA and reserve prices are explained in further detail in Section VII.

3) Simultaneously, GAM uses the publisher's yield groups to identify the yield partners representing third-party demand sources that are eligible to compete in the unified auction. GAM requests bids from each yield partner. Each yield partner uses an Exchange Bidding integration to run their own auction and return the highest bid.

4) GAM hosts a unified auction that compares the yield partner bids alongside the AdX bid and other remnant and direct line items using EDA. The unified auction is a first-price auction.

5) If an AdX demand source wins the unified auction, GAM returns the AdX demand source's ad. If an Exchange Bidding yield partner wins, GAM returns the yield partner's ad.

210. Figure 24 below shows the different end scenarios in the GAM first-price auction for AdX, Exchange Bidding, and Header Bidding.

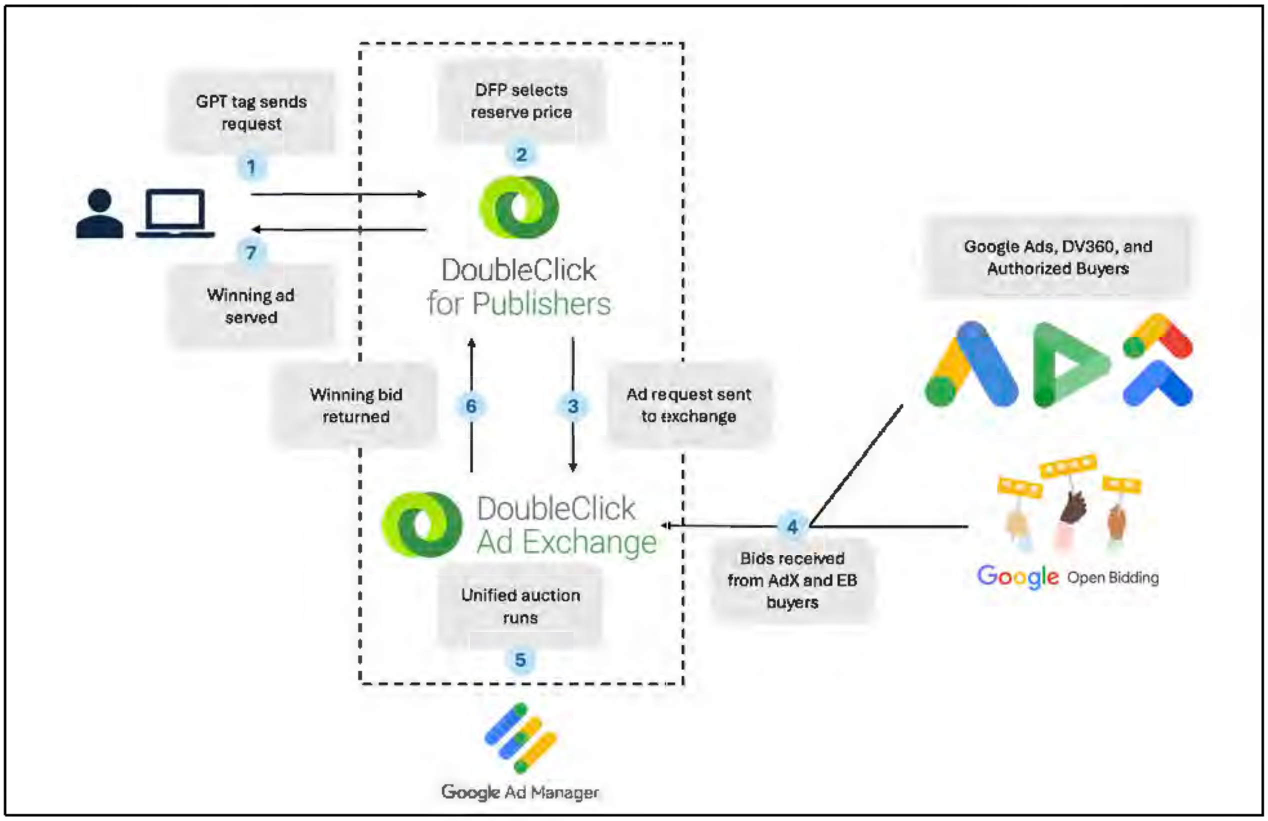
[540] Google internal document, "Exchange Bidding Training," (August 2019) GOOG-TEX-00971841 at '876 (HCI).
[541] Google internal document, "Exchange Bidding Training," (August 2019) GOOG-TEX-00971841 at '876-878 (HCI); Google, "How Open Bidding works," https://support.google.com/admanager/answer/7128958. Accessed May 23, 2024.
[542] "Ad Manager sends the reserve price for the unified auction to all eligible Authorized Buyers and Open Bidding participants (including third-party exchanges or networks). The reserve price is at least the maximum of the temporary CPM calculated by Ad Manager for the best eligible guaranteed line item or the floor price configured by the publisher[.]" Google, "How Open Bidding works," https://support.google.com/admanager/answer/7128958. Accessed May 23, 2024.

Figure 24: Winning scenarios for AdX, Exchange Bidding, and Header Bidding

Bid Source	Net Bid CPM	First-Price Auction Winner	Cost Paid
Scenario 1: AdX wins			
Header Bidding	$ 5	AdX 1	$ 6
AdX 1	$ 6		
AdX 2	$ 5		
Exchange Bidding 1	$ 4		
Exchange Bidding 2	$ 5.50		
Scenario 2: Exchange Bidding wins			
Header Bidding	$ 5	Exchange Bidding 1	$ 6.25
AdX 1	$ 6		
AdX 2	$ 5		
Exchange Bidding 1	$ 6.25		
Exchange Bidding 2	$ 5.50		
Scenario 3: Header Bidding wins			
Header Bidding	$ 6.50	Header Bidding	$ 6.50
AdX 1	$ 6		
AdX 2	$ 5		
Exchange Bidding 1	$ 4		
Exchange Bidding 2	$ 5.50		

211. Figure 25 below shows the Exchange Bidding workflow.

Figure 25: Exchange Bidding workflow with GAM



212. Exchange Bidding, as a server-side solution that facilitated competition with third-party demand sources, resulted in both technical benefits and drawbacks for publishers. As discussed above in Section D, server-side solutions like server-side Header Bidding allow for lower latency and more auction participants compared to client-side solutions. However, as also discussed in Section D, server-side solutions generally have less transparency on how the external server runs the auction. This was also true for publishers using Exchange Bidding, especially if they were also using Header Bidding at the same time. For example, Google limited the information in data files about its auctions, which included:[543]

1) "Bid Data Transfer" files: These files include records of bids received by AdX and records of bids by third-party demand sources bidding through Exchange Bidding, but not bids that came from Header Bidding. These files also include bidding data such as bidder

543 [redacted]; Australian Competition & Consumer Commission, "Digital advertising services inquiry," (August 2021) https://www.accc.gov.au/system/files/Digital%20advertising%20services%20inquiry%20-%20final%20report.pdf, p. 150. Accessed May 24, 2024.

name, bidder price, and whether the bid won or lost. Information about the ad impression, such as the price at which the impression was sold, is not included.

2) "Impression Data Transfer" files: These files include information about the price at which an impression was sold, and the bids of Header Bidding demand sources.

213. Before September 2019, publishers that wished to compare the performance of all bids and buyers (*i.e.*, AdX buyers, Exchange Bidding buyers, and Header Bidding buyers) for a particular impression could do so by matching the data in "Bid Data Transfer" files and "Impression Data Transfer" files. However, in September 2019 Google prevented publishers from matching these files as part of its transition to first-price unified auctions, citing the need to "prevent bid data from being tied to individual users[.]"[544] This consequently made it more difficult for publishers to compare Google's demand sources with other demand sources, as I explain below.[545]

214. Google prevented matching by changing some of the data fields in the Bid Data Transfer files. One field, "KeyPart," was a unique value that could be used to match with data transfer files that might contain user data from bidders, such as the user's device, browser, cookies, or unique identifier.[546] Another field, "TimeUsec2," was a timestamp for an auction that was recorded at the microsecond level.[547] Before September 2019, the combination of the KeyPart and TimeUsec2 fields could uniquely identify all information about an auction (*e.g.*, bids, bidders, and impressions) across the Bid Data Transfer files and Impression Data Transfer files. Subsequently, Google made changes to both fields in the Bid Data Transfer files such that matching was no longer possible:[548]

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[544] Bigler J., "Rolling out first price auctions to Google Ad Manager partners," (September 5, 2019) https://blog.google/products/admanager/rolling-out-first-price-auctions-google-ad-manager-partners/. Accessed May 23, 2024.
[545] Australian Competition & Consumer Commission, "Digital advertising services inquiry," (August 2021) https://www.accc.gov.au/system/files/Digital%20advertising%20services%20inquiry%20-%20final%20report.pdf, p. 150. Accessed May 24, 2024.
[546] Google internal document, "Digital Advertising Market Study: Follow-up to Google/CMA meeting on 28 October 2019," GOOG-AT-MDL-006690096 at '111 (CI); Google internal document, "Bid DT Changes for 1st Price Auction," (July 25, 2019) GOOG-NE-07834872 at '874 (HCI).
[547] Google internal document, "Digital Advertising Market Study: Follow-up to Google/CMA meeting on 28 October 2019," GOOG-AT-MDL-006690096 at '111 (CI); [redacted]).
[548] Google internal document, "Digital Advertising Market Study: Follow-up to Google/CMA meeting on 28 October 2019," GOOG-AT-MDL-006690096 at '111 (CI); [redacted]

1) The KeyPart field itself was "re-encoded" in the Bid Data Transfer files. This meant that for the same auction, the KeyPart in the Bid Data Transfer file was different than the KeyPart in other files, such as the Impression Data Transfer file. With no knowledge on how the KeyPart was re-encoded, publishers could not use this field to match the Bid Data Transfer files with other files.

2) Timestamps, including the TimeUsec2 field, were rounded such that they were recorded at the hour level, instead of at the microsecond level. Because the auction process occurs in seconds or even fractions of a second,[549] only having data at the hour level meant that publishers could no longer precisely match bids with an impression using timestamps.

215. Moreover, the BidPrice field of the winning bids would be rounded to increments of $0.10, while the BidAdvertiser, BidYieldGroupCompanyId, and BidYieldGroupNames fields were redacted entirely.[550]

216. This example with the Bid Data Transfer files shows that Google was able to limit information and transparency about its auctions to publishers.

217. To conclude, Exchange Bidding was Google's response to Header Bidding with a self-stated goal of resolving the technical challenges of Header Bidding. Unlike Header Bidding, which is usually implemented on the client-side, Exchange Bidding is a server-side solution, meaning that Google controls and mediates the process of interacting with bidders. As a result, exchange bidding resulted in in reduced visibility into the auction dynamics on the external server. Google states that Exchange Bidding demand sources and AdX demand sources compete equally in the unified auction on a net basis.

X. GOOGLE IMPLEMENTS PROJECT BERNANKE TO ADJUST GOOGLE ADS USERS' BIDS

A. Google released four iterations of Project Bernanke which adjusted Google's ad buying tool bids to win more auctions

218. Project Bernanke is an internal Google program within Google Ads designed to adjust advertiser bids to increase the numbers of auctions won by Google Ads in AdX and increase the

549 See [redacted] Deposition, (April 3, 2024) at 169:20-171:20.
550 [redacted]

revenue of Google Ads.[551] Project Bernanke was implemented in four phases – "Original Bernanke" in 2013, "Global Bernanke" in 2015, "Project Bell v2" in 2016 and "1P Bernanke" in 2019. Original Bernanke, Global Bernanke, and 1P Bernanke all maintained Bernanke pool(s) of money to subsidize bids in auctions where Google Ads bids would have lost, and recouped money through bid adjustments in auctions where bids from Google Ads bidders ranked on top.[552] Project Bernanke continued to operate in Google Ads as of the "June 2023" code snapshot (the most recent provided by Google).[553]

219. As previously stated, Google Ads has an internal buy-side auction, the CAT2 auction, that determines the highest Google Ads bids for submission into the AdX auction.[554] Within CAT2, the top one or two Google Ads bids, depending on the type of AdX auction, are selected[555] and submitted to compete in the AdX auction.[556] If a Google Ads bid wins the AdX auction, Google Ads takes a [redacted]%[557] revenue share from the payment made by the winning advertiser, which it extracts prior to the submission into the auction (*e.g.*, if the advertiser bid [redacted], the bid that went into the AdX auction would be for [redacted] to reflect a [redacted] revenue share for Google).[558]

220. At its launch, AdX operated as a modified second-price auction, meaning that the highest-bidding advertiser won the impression and paid the higher of either the reserve price or the

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551 [redacted] Google internal document, "Promo Packet," (September 5, 2019) GOOG-AT-MDL-B-002547429 at '430 (CI); [redacted] Deposition, (April 1, 2024) at 57:11-57:18; Google internal document, "Project Bernanke," (October 21, 2013) GOOG-AT-MDL-009831407 at '409 (CI); [redacted] Deposition, (April 3, 2024) at 195:22-197:8.

552 Google internal document, "Native Formats Update," GOOG-NE-02635108 at '112 (HCI); Google internal document, "The Alchemist," (March 2019) GOOG-DOJ-AT-02224828 at '828 (HCI); Google internal document, "Alchemist: the Game of Arbitrage," GOOG-DOJ-AT-00568762 at '762 (HCI); [redacted] Deposition (April 26, 2024) at 94:2-8.

553 See Appendix C Section B.19 for confirmation based on my analysis of Google's source code on Bernanke implementation in 2023.

554 [redacted] Google internal document, "CAT2 First Price Auction," GOOG-AT-MDL-018531517 at '520 (HCI) [redacted]

555 Prior to 2019, when AdX ran second-price auctions, CAT2 submitted up to two bids to AdX. In some cases, Google Ads could submit one or zero bids if it didn't have enough bids for a specific auction. Since AdX switched to a first-price model in 2019, CAT2 has been submitting only one bid.

556 Google internal document, "Supermixer," (January 2020) GOOG-AT-MDL-001421306 at' 308 (HCI); Google internal document, "CAT2 First Price Auction," GOOG-AT-MDL-018531517 at '520 (HCI).

557 Google Ads revenue share increased from [redacted] to [redacted] in the period between 2013 and 2016. Google internal document, "AdX Auction Optimizations," (May 10, 2016) GOOG-NE-06842715 at '730 (HCI).

558 Google internal document, "Native Formats Update," GOOG-NE-02635108 at '112 (HCI); Google internal document, "Quality Revenue Optimizations Overview," (June, 2020) GOOG-DOJ-AT-01509153 at '153 (HCI).

amount of the second highest bid.[559] In 2019, AdX switched to a first-price model, where the highest-bidding advertiser above the reserve price wins and pays the exact amount they bid.[560] After the 2019 AdX first-price transition, Google Ads converted its second-price bids into equivalent first-price bids prior to submission into AdX.[561,562] CAT2 functioned as a modified second-price auction until it started transition to first-price style in 2021.[563] In 2021, Google Ads transitioned a portion of its ads to first-price bids, without conversion, while some remained second-price, depending on the bidding strategy.[564] A CAT2 first-price document from 2021 notes that CAT2 first-price supported fixed CPA[565] and target CPA bidding strategies.[566] All other ads, such as manual ads, would bid second-price values.[567] Figure 26 provides a timeline of all Project Bernanke changes, as well as the AdX and CAT2 auction types.

559 Bigler, J., "Rolling out first price auctions to Google Ad Manager Partners," (September 5, 2019) https://blog.google/products/admanager/rolling-out-first-price-auctions-google-ad-manager-partners/. Accessed May 23, 2024; Google internal document, "AdX + gTrade Overview," (October 14, 2014) GOOG-DOJ-AT-00245254 at '261 (HCI).

560 Bigler, J., "Rolling out first price auctions to Google Ad Manager Partners," (September 5, 2019) https://blog.google/products/admanager/rolling-out-first-price-auctions-google-ad-manager-partners/. Accessed May 23, 2024; Zaiceva, A., setupad, "First-Price vs. Second-Price Auction | Difference Explained," (April 22, 2021) https://setupad.com/blog/first-price-vs-second-price-auction/. Accessed May 23, 2024.

561 Google internal document, "The Alchemist," (March 2019) GOOG-DOJ-AT-02224828 at '829 (HCI).

562 The bids for second-price auction are thus converted to bids for first-price auction based on bid shading, as bidders in first-price auction are not incentivized to bid their true value as in second-price auction. *See* Weinberg Report, para. 48.

563 Google internal document, "Bidding Optimization for TaskAds & Survey," GOOG-DOJ-AT-02246549 at '553 (HCI).

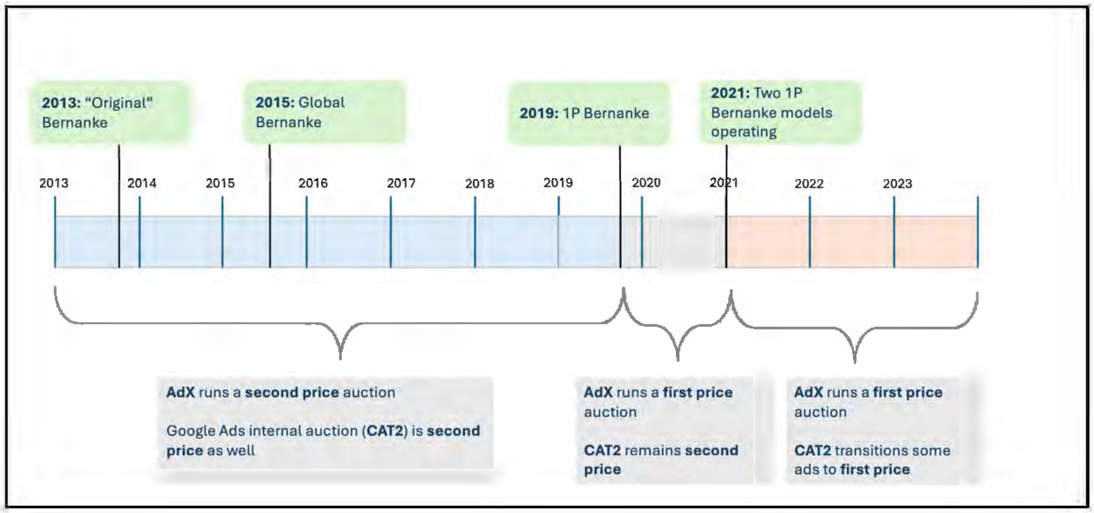
564 Google internal document, "CAT2 1P," (September 29, 2021) GOOG-AT-MDL-001132667 at '669 (HCI).

565 CPA is "cost-per-action" where action is typically a purchase, registration, signup, etc.

566 Google internal document, "CAT2 1P," (September 29, 2021) GOOG-AT-MDL-001132667 at '669 (HCI).

567 UAC, GVP ads, video CTD ads, and Gmail front fill ads; Google internal document, "CAT2 First Price Auction," GOOG-AT-MDL-018531517 at '519 (HCI).

Figure 26: Timeline of Project Bernanke, AdX auction type, and CAT2 auction type



221. Google's implementation of Project Bernanke in 2013 leveraged two factors: (1) Google Ads submitted two bids into the AdX auction, and (2) Google Ads bids were often the two highest bids in the auction.[568] Google internally explained its two-bid strategy was meant to subsidize publishers, as Google Ads submitting two bids considerably increased publisher revenue.[569] For example, if Google Ads submitted a $1.00 and an $0.80 bid into an auction where the highest non-Google bid was $0.50, Google Ads won, and as a second-price auction, the advertiser paid $0.80. If Google Ads had only placed one bid, the advertiser would have paid $0.50. According to an internal Google analysis, if Google Ads stopped submitting two bids, publishers stood to lose [redacted] of their revenue.[570] Additionally, Google Ads reported that it won about [redacted] of all auctions in AdX and submitted the top two bids on approximately [redacted] of those auctions.[571] This meant that on approximately [redacted][572] of all auctions in AdX, Google already controlled advertiser cost and publisher payout. The large number of AdX auctions in which Google controlled the top bids and payouts gave Google the opportunity to adjust bids, advertiser costs, and publisher payouts through an undisclosed program called Project Bernanke.

568 Google internal document, "gTrade Team Background," GOOG-NE-13624783 at '785 (HCI).
569 Google internal document, "Aligning for a Programmatic Future," GOOG-NE-11902954 at '966 (HCI).
570 Google internal document, "Project Bernanke and margins story," (2019) GOOG-AT-MDL-001412616 at '619 (CI).
571 Google internal document, "gTrade Team Background," GOOG-NE-13624783 at '785 (HCI).
572 85% of 50%.

B. The original version of Project Bernanke adjusted bids while maintaining a fixed margin per publisher

222. The first version of Project Bernanke, "original Bernanke," was launched on November 11, 2013 on all AdX ad opportunities.[573] The program functioned by accumulating pools of money from some auctions and using that money to inflate bids in other auctions.[574] More specifically, in auctions where Google Ads bids were higher than the floor and other bids in the auction, Google Ads could decrease advertiser bids to secure ad impressions at a lower cost, while still charging the advertiser the higher price for the impression.[575] Conversely, when Google Ads bids were not high enough to win an auction, Bernanke could inflate advertiser bids to win the auction while only charging the advertisers the lower cost of their original bid.[576] Figure 27 and Figure 28 provides a visual of the scenario in which Bernanke was used to build a Bernanke pool on auctions where Google Ads placed the two highest bids and a scenario in which Bernanke was used to subsidize a bid Google Ads would have otherwise lost. A predictive algorithm determined whether to collect money or subsidize bids in each auction prior to submission into AdX.[577]

[573] [redacted] Deposition, (April 26, 2024) at 112:11-14; Google's First Am. Resps. and Objs. to Plaintiff's Third Set of Interrogs. (May 24, 2024) at 12.
[574] Google internal document, "gTrade Team Background," GOOG-NE-13624783 at '785 (HCI).
[575] Google internal document, "gTrade Team Background," GOOG-NE-13624783 at '785 (HCI); [redacted] Deposition, (April 26, 2024) at 319:21-320:5.
[576] Google internal document, "gTrade Team Background," GOOG-NE-13624783 at '785 (HCI).
[577] Google internal document, "Project Bernanke and margins story," (2019) GOOG-AT-MDL-001412616 at '622 (CI).

Figure 27: Bernanke was used to build the Bernanke pool in auctions where Google Ads places the two highest bids

[redacted]

Figure 28: Bernanke subsidized bids with money from the Bernanke pool in auctions Google would've otherwise lost

[redacted]

223. [redacted]

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578 Google internal document, "AdX + gTrade Overview" (October 14, 2014) GOOG-DOJ-AT-00245254 at '283 (HCI); [redacted] Deposition, (April 26, 2024) at 108:8-109:16.

"[redacted]

224. In the context of Bernanke, the process of applying *alpha* and *beta* multipliers to live auction traffic is referred to as "online experiments."[583] The process of data collection and model training on past data is referred to as "offline experiments" in the context of Bernanke.[584] Bernanke's online and offline experiments are described in detail in Appendix C Section B.

225. The *alpha* and *beta* multipliers that are computed by the prediction model are used to adjust the top two Google Ads bids prior to submission into AdX – the highest Google Ads bid is multiplied by *alpha*, whereas the second-highest Google Ads bid is multiplied by *beta*.[585] In the first two versions of Project Bernanke – original Bernanke and Global Bernanke – *alpha* ranged between [redacted] meaning the highest bid could be inflated up to [redacted] its original value,

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579 Google internal document, "AdX + gTrade Overview," (October 14, 2014) GOOG-DOJ-AT-00245254 at '283 (HCI).

580 See Appendix C Section B.3 for findings from my analysis of Google's source code on the configuration of Bernanke offline experiments.

581 "Online experiments" in this context meaning situations in which exploratory values of Bernanke multipliers are applied to live auction traffic. See Appendix C Section B.22 for findings from my analysis of Google's source code on the configurations of Bernanke online experiments.

582 [redacted]. See Google internal document, "Rethinking Bernanke: Grid search to line search," (October 30, 2014) GOOG-AT-MDL-008881638 at '638 (HCI).

583 See Appendix C Section B.22 for findings from my analysis of Google's source code on the configurations of Bernanke online experiments.

584 Google internal document, "Rethinking Bernanke: Grid search to line search," (October 30, 2014) GOOG-AT-MDL-008881638 at '638 (HCI); Google internal document, "Project Bernanke and margins story," (2019) GOOG-AT-MDL-001412616 at '622 (CI); see Appendix C Section B.3 for findings from my analysis of Google's source code on the configuration of Bernanke offline experiments.

585 Google internal document, "Rethinking Bernanke: Grid search to line search," (October 30, 2014) GOOG-AT-MDL-008881638 at '638 (HCI); Google internal document, "Bernanke and Bell," GOOG-AT-MDL-018243919 at '921, '925 (HCI).

while *beta* ranged from [redacted], meaning the second-highest bid value was lowered anywhere from [redacted] of its original value.[586]

226. In the context of a second-price auction, which was how AdX functioned during the first two versions of Project Bernanke, the application of the *beta* multiplier on the second bid decreased the second highest bid, and consequently, the publisher payout.[587] In auctions where the predictive algorithm determined that Google Ads would have the two highest bids, the *beta* multiplier would decrease the second-highest bid; however, the advertiser would still be charged the original value of the second bid, prior to the application of the *beta* multiplier.[588] The difference between advertiser charge and publisher payout left Google Ads with a surplus of money. Google Ads retains its contractual [redacted] revenue share by subtracting from the surplus and placed the rest in a pool, which I refer to as the Bernanke pool.[589]

227. [redacted]

228. Figure 29 shows an example auction that demonstrates how Google built a pool using original Bernanke. Take an auction where Google Ads submits the two highest bids, $1.20 and

586 Google internal document, "Bernanke and Bell," GOOG-AT-MDL-018243919 at '921, '925 (HCI); [redacted] Deposition, (April 26, 2024) at 109:18-21.
587 Google internal document, GOOG-AT-MDL-016354537 at '540 (CI).
588 Google internal document, GOOG-AT-MDL-016354537 at '540 (CI).
589 Google internal document, GOOG-AT-MDL-016354537 at '540 (CI).
590 Google internal document, GOOG-AT-MDL-016354537 at '540 (CI).
591 Google internal document, GOOG-AT-MDL-016354537 at '540 (CI).
592 Google internal document, GOOG-AT-MDL-016354537 at '542 (CI).
593 See Appendix C Section B.20 for findings from my analysis of Google's on the implementation of Bernanke pool for bid adjustment.
594 See Appendix C Section B.21 for findings from my analysis of Google's on the implementation of Bernanke pool for safety mechanism.

$1.00. Without Bernanke, the highest bid b_1 would win, and the advertiser would pay the amount of the second-highest bid, $1.00. Google Ads would keep [redacted] of what the advertiser paid, which is [redacted] in this example. The remaining [redacted] would be split across AdX's revenue share and the publisher's payout.

Figure 29: Example of an auction in which Google uses Bernanke to take a higher revenue share and build a Bernanke pool

	Bids	Auction Winner	Advertiser Charge	Publisher + AdX Payout	Google Ads Revenue + Bernanke Pool
Without Bernanke	(Google Ads) b_1 = \$1.20 (Google Ads) b_2 = \$1.00 (Non-GA) b_3 = \$0.50	b_1	\$1.00	[redacted]	
With Bernanke	**Bernanke multipliers:** $\alpha = 1$ $\beta = 0.1$ **Adjusted bids:** (Google Ads) $b_1 = 1.2 \cdot 1$ = \$1.20 (Google Ads) $b_2 = 1.0 \cdot 0.1$ = \$0.10 (Non – GA) b_3 = \$0.50	b_1	\$1.00	\$0.50	\$0.50

229. With Bernanke enabled and with *alpha* and *beta* multipliers equal to 1 and 0.1, respectively, Google Ads' second bid b_2 is multiplied by 0.1, reducing b_2 from $1.00 to $0.10 and making b_3, with a value of $0.50, the second-highest bid in the auction.[595] Consequently, Google Ads wins, pays the new second-highest value, $0.50, to the publisher but still charges the advertiser the original value of the second bid ($1.00). In summary, Google charges the advertiser $1.00, while paying the publisher (and the AdX revenue share) $0.50, leaving $0.50 or 50% for Google Ads' revenue share and the Bernanke pool.[596]

230. Figure 30 shows an example auction where original Bernanke helps a Google Ads advertiser to win an auction it would have otherwise lost. In this example, assume the auction provided is from the same publisher as in Figure 29, which means that Google has money in the Bernanke pool to spend (its revenue share for this publisher is currently 50%). The bid b_1 is $1.03 by a non-Google Ads bidder and is the highest value in the auction. Since Google Ads' highest bid

[595] The value of b_3 is either the original third-highest bid in the auction or the auction floor, whichever one is higher.

[596] This example is modeled after example provided in Google document, GOOG-AT-MDL-016354537 at '540 (CI).

is b_2 with a value of \$0.80, Google would lose the auction without Bernanke. The Bernanke algorithm computes an *alpha* multiplier that raises Google's highest bid to \$1.04, making it just high enough to be the new auction winner, while \$1.03 becomes the second-highest bid. Consequently, Google charges the advertiser \$0.80 and uses \$0.23 from the Bernanke pool to subsidize the rest of the publisher and AdX payout. The advertiser is charged their bid as they would be in a first-price auction.

231. In summary, in the absence of Bernanke, Google Ads would have won one auction and made a total of [redacted] across the two examples.[597] With Bernanke enabled, Google Ads wins two auctions, the advertiser spent \$1.80 and Google's revenue was [redacted] of the advertiser's spend.

Figure 30: Example of an auction in which Google uses Bernanke to win an auction it would have otherwise lost

	Bids	Auction Winner	Advertiser Charge	Publisher + AdX Payout	Google Ads Revenue + Bernanke Pool
Without Bernanke	(Non – GA) b_1 = \$1.03 (Google Ads) b_2 = \$0.80	b_1	NA (Not to Google)	NA (Not to Google)	\$0.00 (didn't win)
With Bernanke	**Bernanke multipliers:** $\alpha = 1.3$ $\beta = 1$ **Adjusted Bids:** (Non – GA) b_1 = \$1.03 (Google Ads) $b_2 = 0.80 \cdot 1.3 = \$1.04$	b_2	\$0.80	\$1.03	\$-0.23

C. Google uses a series of background experiments to calculate optimal values for Bernanke multipliers

232. In this section, I describe the experiments used to calculate the optimal Bernanke multipliers as observed in the "June 2023" Google code snapshot, although the implementation of these background experiments varied over time. As previously stated, the Bernanke *alpha* and *beta* multipliers are calculated from a series of offline experiments run on historical auction data, while online experiments specify which set of *alpha* and *beta* multipliers to be applied to what percentage of live auction traffic.[598]

[597] This example is modeled after example provided in Google internal document, GOOG-AT-MDL-016354537 at '540 (CI).
[598] Details about online and offline experiments are covered in Section X.C.

233. Offline experiments refer to the implementation of model training that occurs offline and are conducted independently of the auction occurring in real-time. Offline experiments use historical auction data to determine the optimal values of model parameters to be used in production, and typically consist of three parts:

A data pipeline to prepare training data.

2) A model pipeline to optimize model parameters.

3) Configuration hyperparameters to control the offline training process, including the frequency of training, and the input and output file paths.

234. [redacted]

599 Google data production, samples of Google Ad Manager (GAM) log-level bid data produced on May 12, 2023.

600 See Appendix C Section B.22 for findings from my analysis of Google's source code on the configurations of Bernanke online experiments.

601 See Appendix C Section B.23 for findings from my analysis of Google's source code on Bernanke training data and data pipeline.

602 See Appendix C Section B.23 for findings from my analysis of Google's source code on Bernanke training data and data pipeline.

603 See Appendix C Section B.24 for findings from source code analysis on determination of optimal Bernanke multipliers.

[redacted][604,605,606]

235. [redacted].[607]

236. Online experiments refer to the configuration of parameters that are applied in live auctions, *i.e.*, the live auction execution loads parameter values specified in online experiment files. Online experiments typically consist of multiple sets of parameter values and serve to measure the impact of various parameter values on the auction outcome.[608]

237. Online experiments specify how Bernanke should be applied in the live auction, including the specific values of Bernanke parameters to be used, and the percentage of live traffic to apply the values on.[609] The values of Bernanke parameters, including Bernanke multipliers and pool-related fields (*e.g.*, pool id, and pool thresholds), are specified in two parts of a Bernanke online experiment file:

1) [redacted].[610]

2) [redacted]

604 Google internal document, "Project Bernanke," (October 21, 2013) GOOG-AT-MDL-007393310 at '313 (CI).
605 See Appendix C Section B.3 for findings from my analysis of Google's source code on the configuration of Bernanke offline experiments.
606 See Appendix C Section B.23 for findings from my analysis of Google's source code on Bernanke training data and data pipeline.
607 For specific values, see Appendix C Section B.25 for findings from my analysis of Google's source code on details about Bernanke SSTable.
608 See Appendix C Section B.22 for findings from my analysis of Google's source code on the configurations of Bernanke online experiments.
609 See Appendix C Section B.22 for findings from my analysis of Google's source code on the configurations of Bernanke online experiments.
610 See Appendix C Section B.22 for findings from my analysis of Google's source code on the configurations of Bernanke online experiments.

[redacted].[611]

238. The percentage of auctions subject to Bernanke offline experiments and the mechanism of those experiments varied over time. For example, an internal Google document from 2013 states that the online experiments applied to [redacted] of auctions and raised the first bid four times its value, while lowering the second bid to zero.[612] A document from 2014, on the other hand, suggests that experiments tested various combinations of *alpha* and *beta* parameters, and the pair that maximized Google Ads profit was selected.[613] Google bids sub-optimally on auctions that are part of certain online experiments to gather data for Bernanke.[614]

239. To safeguard against extreme deviations from the target margin, Google implemented an online safety mechanism for Bernanke.[615] In this context, online means that the safety mechanism went into effect live, for each individual auction, after bid submission.[616,617] The safety mechanism calculated the expected margin for each publisher and would stop lowering the second bid if the expected margin exceeded [redacted] Similarly, it would stop increasing the first bid if the expected margin fell below [redacted].[618] In original Bernanke, the safety mechanism was maintained at per-publisher level. This meant that during the application of Bernanke bid adjustment, if the profit margin exceeded the target range for a given publisher, the safety mechanism would be triggered to override the values of *alpha* and *beta* multipliers with pre-defined values.[619]

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611 See Appendix C Section B.22 for findings from my analysis of Google's source code on the configurations of Bernanke online experiments.

612 Google internal document, "Project Bernanke," (October 21, 2013) GOOG-AT-MDL-007393310 at '312 (CI).

613 Google internal document, "Rethinking Bernanke: Grid search to line search," (October 30, 2014) GOOG-AT-MDL-008881638 at '638 (HCI).

614 Google internal document, "Smarter Exploration for Bernanke," (October 28, 2020) GOOG-DOJ-AT-02260412 at '412 (HCI).

615 Google internal document, "Project Bernanke," (October 21, 2013) GOOG-AT-MDL-007393310 at '313 (CI).

616 Google internal document, "Project Bernanke," (October 21, 2013) GOOG-AT-MDL-007393310 at '313 (CI); Google internal document, "1P Bernanke Pool Safety Mechanism Design Doc," (December 9, 2020) GOOG-AT-MDL-002307536 at '539 (HCI).

617 See Appendix C Section B.21 for findings from my analysis of Google's on the implementation of Bernanke pool for safety mechanism.

618 Google internal document, "Project Bernanke," (October 21, 2013) GOOG-AT-MDL-007393310 at '313 (CI).

619 See Appendix C Section B.21 for findings from my analysis of Google's on the implementation of Bernanke pool for safety mechanism; [redacted] Deposition, (April 26, 2024) at 97:10-13.

240. Additionally, Google used a mechanism called "throttling" to disable Bernanke under certain conditions.[620,621] This mechanism controlled the maximum percentage of an advertiser's bids that could be raised via Bernanke.[622] According to internal Google documents, this was done to prevent advertisers from responding to Bernanke by reducing their bid and relying on Google to subsidize the necessary amount to win.[623] Google determined that the optimal throttling percentage per advertiser was [redacted] meaning that at most [redacted] of an advertiser's bids could be raised via Bernanke.[624]

241. A [redacted]

620 Google internal document, "gTrade AdX Summit," (February 5, 2014) GOOG-NE-12949161 at '166, (CI).
621 See Appendix C Section B.4 for findings from my analysis of Google's source code on Bernanke throttling.
622 Google internal document, "gTrade AdX Summit," (February 5, 2014) GOOG-NE-12949161 at '166, (CI).
623 Google internal document, "gTrade AdX Summit," (February 5, 2014) GOOG-NE-12949161 at '166, (CI).
624 Google internal document, "gTrade AdX Summit," (February 5, 2014) GOOG-NE-12949161 at '167, (CI).
625 Google internal document, "Protecting GDN/DBM Advertisers," (September 2016) GOOG-NE-10646295 at '299 (HCI).
626 Google internal document, "Global Bernanke," (October 8, 2014) GOOG-AT-MDL-B-002122273 at '277 (HCI).
627 See Appendix C B.26 for findings from my analysis of Google's source code on the determination of multi-call publishers.
628 See Appendix C Section B.14 for findings from my analysis of Google's source code on the setup of mediation treatment in Bernanke workflow.
629 See Appendix C Section B.15 for findings from my analysis of Google's source code on the implementation of turning off Bernanke for multi-call publishers.

D. Global Bernanke maintained a fixed margin across all publishers

242. Global Bernanke was launched in August of 2015 on all AdX ad opportunities and changed the per-publisher pool to a single pool shared among all publishers.[630,631] Instead of maintaining a pool for each publisher that could only be replenished or used to inflate bids on ad slots from that specific publisher, Google introduced a single pool for all publishers as a group.[632] This meant that the [redacted] revenue margin was now maintained on average across all publishers.[633] Google implemented a similar safety mechanism that prevented individual publisher revenue margin to Google Ads from dropping below [redacted] and publisher payout dropping below [redacted] of the revenue they would have received without Bernanke.[634] In other words, the mechanism aimed to prevent any publisher from losing more than [redacted] of their revenue due to Global Bernanke.[635]

243. Because the safety mechanism in the original Bernanke relied on the fact that Google should receive an average margin of [redacted] for each publisher, this mechanism was disabled when Global Bernanke was launched.[636] Around 2016, Google introduced a version of the safety mechanism for Global Bernanke that disabled Global Bernanke at a threshold, which was set based on publisher size and the estimated cost of the impression.[637]

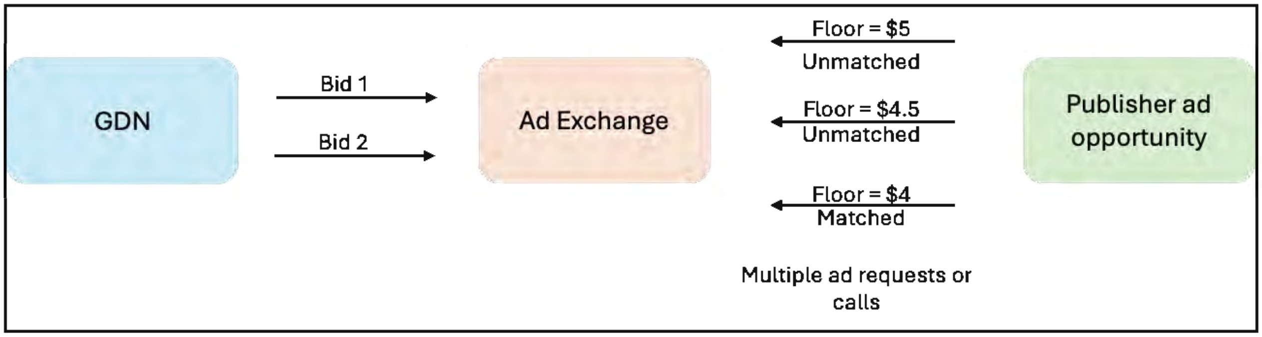
E. Google disabled Bernanke while bidding on multi-call publishers through Project Bell v2

244. In October 2016, Google updated Global Bernanke to include Project Bell v2 which included the detection and management of multiple calls from publishers.[638,639,640,641] Multi-

630 Google's First Amended Responses and Objections to Plaintiff's Third Set of Interrogatories, (May 24, 2024) at 12
631 Google internal email, (May 21, 2015) GOOG-DOJ-15637938 at '938 (HCI); Google internal document, "Global Bernanke," (July 26, 2015) GOOG-DOJ-AT-02471194 at '194 (HCI); [redacted] Deposition, (April 26, 2024) at 96:20-97:13, 112:18-22.
632 Google internal email, (May 21, 2015) GOOG-DOJ-15637938 at '938 (HCI).
633 Google internal document, "Global Bernanke," (July 26, 2015) GOOG-DOJ-AT-02471194 at '194 (HCI).
634 Google internal document, "Global Bernanke," (July 26, 2015) GOOG-DOJ-AT-02471194 at '194 (HCI); [redacted] Deposition, (April 26, 2024) at 98:2-99:5.
635 Google internal document, "Global Bernanke," (July 26, 2015) GOOG-DOJ-AT-02471194 at '194 (HCI).
636 Google internal document, (March 6, 2016) GOOG-NE-13550381 at '381-382 (HCI).
637 Google internal document, (March 6, 2016) GOOG-NE-13550381 at '383-387 (HCI).
638 "Declaration of Nirmal Jayaram," (August 5, 2023) GOOG-AT-MDL-008842383 at '286; [redacted] Deposition, (April 26, 2024) at 104:19-24 (HCI).
639 See Appendix C Section B.26 for findings from my analysis of Google's source code on the determination of multi-call publishers.
640 See Appendix C Section B.14 for findings from my analysis of Google's source code on the setup of mediation treatment in Bernanke workflow.
641 See Appendix C Section B.15 for findings from my analysis of Google's source code on the implementation of turning off Bernanke for multi-call publishers.

calling refers to when a publisher places multiple requests to an ad exchange for a single ad opportunity.[642] Multi-calling publishers can set different floors for each call they make to the ad exchange for the same impression.[643] For example, a multi-calling publisher can send a request to AdX with a price floor of $4.50 for a potential ad opportunity and a second request to AdX for the same ad opportunity with a price floor of $5. Figure 31 demonstrates how publishers send multiple calls on AdX.

Figure 31: Publishers sending multiple calls for a single ad opportunity



245. Prior to Project Bell, when AdX received multiple requests for the same ad opportunity, it would "process them as if these are three different ad calls and come up with three different bids."[644] While the requests are still processed separately, with the introduction of Project Bell v2 Google made three major changes when multi-calling was detected.[645] First, Google turned off Bernanke.[646] Next, Google applied a cap to the bid amount that would be submitted to the ad exchange, limiting how much the advertiser could bid.[647] Finally, Google prevented purchases on third-party exchanges when there was already a call for the same ad opportunity on AdX.[648]

F. Google adjusted the Bernanke algorithm to accommodate the switch to a first-price auction

246. In 2019, when AdX switched to a first-price auction, Google devised a version of Bernanke called "1P Bernanke" or "Alchemist" to mimic the functionality of second-price Bernanke in a first-

642 [redacted] Deposition, (April 26, 2024) at 99:8-14.
643 Google internal document, "Mediation: Double Calls Detection and Treatment," GOOG-AT-MDL-B-001602051 at '059 (CI).
644 [redacted] Deposition, (April 26, 2024) at 100:10-18.
645 [redacted] Deposition, (April 26, 2024) at 100:24-101:13; 105:2-8.
646 Google internal document, "Mediation: Double Calls Detection and Treatment," GOOG-AT-MDL-B-001602051 at '066 (CI); [redacted] Deposition, (April 26, 2024) at 100:24-101:13; 105:2-8.
647 [redacted] Deposition, (April 26, 2024) at 100:24-101:13; 105:2-8.
648 [redacted] Deposition, (April 26, 2024) at 100:24-101:13; 105:2-8.

price auction.[649] 1P Bernanke launched in 2019 on all AdX ad opportunities.[650] [redacted]

247. [redacted]

[649] Google internal document, "The Alchemist," (March 2019) GOOG-DOJ-AT-02224828 at '828 (HCI); [redacted] Deposition, (April 26, 2024) at 107:2-6.
[650] Google's First Am. Resps. and Objs. to Plaintiff's Third Set of Interrogs. (May 24, 2024) at 12; [redacted] Deposition, (April 26, 2024) at 112:23-113:9, 114:17-19.
[651] Google internal document, "The Alchemist," (March 2019) GOOG-DOJ-AT-02224828 at '829 (HCI).
[652] Google internal document, "The Alchemist," (March 2019) GOOG-DOJ-AT-02224828 at '829 (HCI).
[653] Google internal document, "The Alchemist," (March 2019) GOOG-DOJ-AT-02224828 at '829 (HCI).
[654] Google internal document, "The Alchemist," (March 2019) GOOG-DOJ-AT-02224828 at '829 (HCI).
[655] Google internal document, "The Alchemist," (March 2019) GOOG-DOJ-AT-02224828 at '829 (HCI).
[656] Google internal document, "The Alchemist," (March 2019) GOOG-DOJ-AT-02224828 at '829 (HCI).
[657] Google internal document, "The Alchemist's," GOOG-AT-MDL-013274837 at '843 (HCI).
[658] Google data production, samples of Google Ad Manager (GAM) log-level bid data produced on May 12, 2023. [redacted]

[redacted].[660]

[redacted]

248. [redacted]

[redacted].

[659] See Appendix C Section B.29 for findings from source code analysis on the configuration of pHOB model pipeline.
[660] See Appendix C Section B.29 for findings from source code analysis on the configuration of pHOB model pipeline.
[661] Google internal document, "The Alchemist," (March 2019) GOOG-DOJ-AT-02224828 at '829 (HCI).
[662] Google internal document, "The Alchemist," (March 2019) GOOG-DOJ-AT-02224828 at '829 (HCI); Google internal document, "Bidding Optimization for TaskAds and Survey," GOOG-AT-MDL-006692676 at '682 (CI).
[663] See Appendix C Section B.30 for findings from source code analysis on the formula of bid submitted to the AdX auction under 1P Bernanke.
[664] Google internal document, "Alchemist: the Game of Arbitrage," GOOG-DOJ-AT-00568762 at '762 (HCI).
[665] Google internal document, "Alchemist: the Game of Arbitrage," GOOG-DOJ-AT-00568762 at '762 - '763 (HCI).

[redacted]

249. [redacted]

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[666] Google internal document, "Bidding Optimization for TaskAds and Survey," GOOG-AT-MDL-006692676 at '682 -'683 (CI)

[667] Based on Google internal document, "Hoover & Truthful Cost," (July 1, 2020) GOOG-AT-MDL-016353630 at '646 (CI), the formula for charging the advertisers may have been updated to $\max(f(v_1 \times a) / a, v_2 \times b)$.

[668] Google internal document, "The Alchemist's," GOOG-AT-MDL-013274837 at '841 (HCI).

[redacted].[670]

250. Figure 35 outlines the CAT2 serving process after AdX transitioned to a modified first-price auction, while CAT2 remained a modified second-price auction. The general purpose of this process is to charge the advertiser based on the second highest auction value, while submitting a first-price bid into the AdX auction; however, the process is very complex and involves several bid adjustments and sub auctions between different candidates. Since at this point CAT2 functions as a modified second-price auction, each winning bid has a value and a price because the winner does not necessary pay what they bid in a second-price auction.[671]

251. Ads designated as manual bidding and auto bidding participated in the same second-price auction.[672] Manual Google Ads bids are a bidding strategy in which advertisers set bids for individual targeting keywords or placements, while auto bidding ads are ads for which the publisher relinquishes bidding control to Google, for example a bidding strategy that maximizes clicks.[673] Both types of ads competed in a second-price auction within CAT2. Within CAT2 ads were grouped into subcategories and sub auctions were conducted within these groups. The second highest bid in each sub auction was used to determine the price of the winning bid. Sub auction results were compared based on the winning bid and the winner among the sub auctions was priced by the runner up sub auction winner.[674]

252. [redacted]

[669] Google internal document, "The Alchemist's," GOOG-AT-MDL-013274837 at '838 (HCI).
[670] Google internal email, GOOG-AT-MDL-001284725 at '725 – '728 (CI).
[671] Google internal document, "Cat2 1P Auction Infrastructure Design Doc," GOOG-DOJ-AT-00586479 at '484 (HCI). Describes how candidate bids are ranked and "priced" in the CAT2 auction. Candidates have a "bid" and a price because from the perspective of Google Ads advertisers, this is a modified second-price auction.
[672] Google internal document, "Cat2 1P Auction Infrastructure Design Doc," GOOG-DOJ-AT-00586479 at '479 (HCI).
[673] Google, "Manual CPC bidding," https://support.google.com/google-ads/answer/2390250. Accessed May 24, 2024.
[674] Google internal document, "Cat2 1P Auction Infrastructure Design Doc," GOOG-DOJ-AT-00586479 at '484 (HCI).

[redacted].[677]

[redacted]

253. As mentioned earlier, in 2021, CAT2 transitioned a portion of Google Ads bids to first-price.[679] This resulted in a complex bidding ecosystem in which both second-price and first-price ads competed in the CAT2 auction, and "2P" and "1P" Bernanke were applied to the respective

[675] Google internal document, "Cat2 1P Auction Infrastructure Design Doc," GOOG-DOJ-AT-00586479 at '488 (HCI).
[676] This includes programs such as revenue calibration, Hoover, Marple and eCPM capping which are outside the scope of this report.
[677] Google internal document, "Cat2 First Price Auction," GOOG-AT-MDL-018531517 at '520 (HCI).
[678] Google internal document, "Cat2 First Price Auction," GOOG-AT-MDL-018531517 at '520-'521 (HCI).
[679] Google document, "Bidding in Cat2 First Price Auction," GOOG-AT-MDL-000880955 at '956 (CI); See Appendix C Section B.16 for confirmation based on my analysis of Google's source code on the existence of 1P and 2P ads in CAT2 in 2023.

ads.[680] Despite being labeled as "2P" in Google internal documents, this version of Bernanke is not to be confused with earlier versions of Project Bernanke that were intended for bidding into a second-price AdX auction. While both are versions of first-price Bernanke, the algorithm is adjusted for the ad type that it serves and uses separate background experiments for each ad type. [redacted].[681]

254. A CAT2 first-price transition document from 2021 proposed migrating the fixed CPA[682] and target CPA bidding strategies, which are both auto bidding strategies, to first-price. All other ads, such as manual ads, would bid second-price values.[683] The overview of the ad serving process after 2021 is shown in Figure 36. Ads that are first-price are passed through the HDMI model, that serves as the auto-bidding model that determines the optimal bid in a first-price auction given the bidding strategy and the likelihood that the desired outcome (for example a click in a cost-per-click bidding type) will occur.[684] Next, the bids are passed through Bernanke for first-price bids, "1P Bernanke," before being submitted into the CAT2 first-price auction. Second-price or manual ads are passed through a separate Bernanke model for second-price ads, "2P Bernanke," and submitted into the CAT2 first-price auction along with the first-price bids.

255. According to the CAT2 first-price design document, the application of both types of Bernanke's translated first- and second-price bids into the same "units," meaning they can be compared in the CAT2 auction. The CAT2 auction was modified to be able to price both bid types. [redacted]".

256. DV360 PPO bids are also determined by the HDMI model and have first-price Bernanke applied and then compete in their own auction where the top bids are submitted into the mini

[680] Google document, "Bidding in Cat2 First Price Auction," GOOG-AT-MDL-000880955 at '965 (CI); See Appendix C Section B.19 for confirmation based on my analysis of Google's source code on Bernanke implementation in 2023.
[681] Google document, "Dynamic Backgrounds for Bernanke on Web," GOOG-AT-MDL-013211457 at'457 (HCI).
[682] CPA is "cost-per-action" where action is typically a purchase, registration, signup, etc.
[683] Google document, "CAT2 First Price Auction," GOOG-AT-MDL-018531517 at '519 (HCI).
[684] "HDMI (Hidden Density Model of Inventory) is a modelling and optimization engine used for auto-bidding. HDMI solves the optimization problem of any bidding strategy by finding the optimal [function] that maximizes the bidding strategy goal." Google internal document, "A brief overview of HDMI," GOOG-AT-MDL-004434946 at '946 (HCI); Google document, "CAT2 1P," (September 29, 2021) GOOG-AT-MDL-001132667 at '261 (HCI).

auction.[685] The mini auction compares PPO and CAT2 auction bids. In the mini auction, the selection of the winner amongst the PPO bids and Google Ads bids remains the same as before the CAT2 transition to first-price. However, the price bid update changed depending on whether the winning bid is first- or second-price. If the winning bid is first-price, the price of the bid remains unchanged, but if the bid is second-price, its value is adjusted based on the runner up bid and the Bernanke multipliers applied to both bids. The winning bid is adjusted by Google's bid adjustment algorithms and sent to the surplus maximizer function. The surplus maximizer function takes in the prediction of outside competition in AdX and uses that value to adjust the final winning bid prior to placement in AdX.[686]

257. Non-PPO bids in DV360 are submitted directly into the AdX auction after the top bid is selected and by-pass the serving flow used when CAT2 ran a second-price auction and after it transitioned to first-price.[687]

[redacted]

XI. GOOGLE IMPLEMENTS DYNAMIC REVENUE SHARE TO MODIFY THE ADX TAKE RATE

685 Google document, "CAT2 1P," (September 29, 2021) GOOG-AT-MDL-001132667 at '681 (HCI).
686 Google internal document, "CAT2 First Price Auction," GOOG-AT-MDL-018531517 at '521 (HCI). The surplus maximizer function takes in the "pHOB" which is the prediction of the highest-other-bid in the auction.
687 Google internal document, "CAT2 First Price Auction," GOOG-AT-MDL-018531517 at '533 (HCI).
688 Google internal document, "Bidding in Cat2 First Price Auction," GOOG-AT-MDL-000880955 at '965 (CI).

A. Google released three versions of the DRS program

258. Google released the "Dynamic Revenue Share" (DRS) feature within AdX on August 20, 2015 to increase the number of auctions in AdX that produced a winning bid.[689] Prior to DRS, AdX calculated a 20% take rate from the clearing price of each auction in AdX.[690] The remaining 80% of the bid must have been greater than the floor price for the bid to win the auction.[691]

259. As discussed in Section VII, sometimes AdX would lose its own auction because the highest AdX bid may not have cleared the EDA floor price; in these cases a guaranteed or remnant line item (depending on which was used to inform the floor price) would win the auction. Google's response was to design a program for AdX to clear the EDA floor price, even in situations where AdX would otherwise not have won the impression. This program reduced Google's take rate in some AdX auctions so that the highest bid, minus Google's reduced share, would clear the EDA floor price.[692] Google internally referred to this program as "Dynamic Revenue Share" (DRS). Google exempted their own buying platforms, Google Ads and DV360, from DRS v1 and v2, only applying these versions of DRS to non-Google buying tools[693] bidding in AdX.[694]

260. Google released three versions of DRS: DRS v1 on August 20, 2015, DRS v2 on December 1, 2016, and truthful DRS (tDRS) on July 17, 2018.[695] The first version of DRS lowered Google's take rate if doing so allowed a bid to win the auction as described above.[696] The second version of

[689] Google's First Amended Responses and Objections to Plaintiff's Third Set of Interrogatories, (May 24, 2024) at 12; Google internal document, "Remove First Pricing in Sell-Side Dynamic Revenue Share," GOOG-NE-13204977 at '981 (HCI).
[690] Google internal document, "AdX dynamic sell-side revenue share (DRS v1) – project description / Mini PRD," GOOG-AT-MDL-009013303 at '303 (HCI); The 20% AdX revenue share percentage is not to be confused with the [redacted] taken by Google Ads. If a bid from Google Ads is placed into AdX, the [redacted] (can be less or more if Bernanke is operating on the bid) will be subtracted by Google Ads first. If this bid wins, the 20% will then be taken by AdX; While 20% was the default rate, some publishers negotiated lower rates. [redacted] Deposition, (April 19, 2024) at 214:8-19.
[691] Google internal document, "Remove First Pricing in Sell-Side Dynamic Revenue Share," GOOG-NE-13204977 at '978 (HCI)
[692] Google internal document, "AdX dynamic sell-side revenue share (DRS v1) – project description / Mini PRD," GOOG-AT-MDL-009013303 at '303 (HCI); [redacted] Deposition, (April 26, 2024) at 268:8-18; [redacted] Deposition, (April 17, 2024) at 138:1-17.
[693] Authorized buying tools place bids into AdX via the RTB protocol
[694] "One known issue with the current DRS is that it makes the auction untruthful as we determine the AdX revshare after seeing buyers' bids and use winner's bid to price itself (first-pricing) when the bid is within the dynamic region. This could incentivize buyers to bid strategically instead of truthfully to achieve better ROI and has been the key concern preventing AdWords and DBM from using DRS." Google internal document, "Truthful DRS Design Doc," GOOG-NE-13226622 at '622 (HCI).
[695] Google's First Amended Responses and Objections to Plaintiff's Third Set of Interrogatories, (May 24, 2024) at 12.
[696] Google internal document, "Dynamic Sell-Side Revshare," (2015) GOOG-NE-13202025 at '031 (HCI); [redacted] Deposition, (April 17, 2024) at 138:1-21.

DRS raised and lowered the take rate to achieve an average of 20% across auctions.[697] tDRS mimicked the second version of DRS by using a machine learning model to predict the optimal take rate in a given auction without looking at auction bids in real-time.[698] Google shut off the DRS program pending redesign when AdX switched to a first-price auction in 2019.[699]

261. DRS was initially not disclosed to publishers, and publishers were opted into the program without their knowledge.[700] I understand that Google never implemented any way for publishers to opt out of DRS v1.[701]

B. The initial version of DRS (DRS v1) lowered AdX's take rate if doing so allowed the highest AdX bid to exceed the auction floor

262. The first version of DRS was launched in 2015 and only lowered AdX's revenue share, never raising it as in future versions of DRS. If a bid is above the floor, but the 20% AdX revenue share would cause it to fall below the floor, it was said to be in the "dynamic region" where DRS could be applied.[702] A Google internal document from 2016 indicates that [redacted] of all winning bids in the AdX auction were in the "dynamic region" (*i.e.*, these bids were near enough to the floor price that DRS could impact the auction outcome), and thus were eligible for DRS take rate adjustments.[703]

263. With DRS v1, Google was able to dynamically adjust its revenue share from anywhere from 0 to 20 percent.[704] However, I understand that Google believed that DRS created perverse incentives in advertisers and publishers. For example, if advertisers knew that Google was reducing Google's revenue share to win an auction, buyers would have an incentive to reduce their bids.[705] Similarly, if publishers knew that Google was reducing Google's revenue share in order to win auctions, publishers would have an incentive to increase their reserve prices.[706]

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697 Google internal document, "AdX Dynamic Revshare v2: Launch Doc," GOOG-NE-13207241 at '241 (HCI).
698 Google internal document, "Truthful DRS Design Doc," GOOG-NE-13226622 at '622 (HCI).
699 Google internal document, "Dynamic Revenue Share," (May 13, 2016) GOOG-TEX-00858434 at '434 (HCI).
700 Google internal document, "Dynamic Revenue Share," (May 13, 2016) GOOG-TEX-00858434 at '435-436 (HCI).
701 [redacted] Deposition, (April 19, 2024) at 288:12-289:4.
702 Google internal document, "Dynamic Sell-Side Revshare," (2015) GOOG-NE-13202025 at '032 (HCI).
703 Google internal document, "Display Ads Research (Part II)," GOOG-AT-MDL-B-001628818 at '826 (CI).
704 [redacted] Deposition, (April 19, 2024) at 232:25-233:9.
705 Google document, "Dynamic Sell-Side Revshare," GOOG-NE-13202025 at '035-036 (HCI); Google document, "Dynamic Revenue Sharing: V1 and V2," GOOG-AT-MDL-001629019 at '027-038 (CI).
706 Google document, "Dynamic Sell-Side Revshare," GOOG-NE-13202025 at '035-036 (HCI); Google document, "Dynamic Revenue Sharing: V1 and V2," GOOG-AT-MDL-001629019 at '027-038 (CI).

264. Google resolved these incentives by probabilistically throttling queries that were in the dynamic range.[707] Google calculated per-buyer and per-publisher AdX margins throughout the day.[708] For each incoming query, Google flipped a coin to determine whether it would throttle the publisher or the advertiser if the bids were in the dynamic range.[709] After flipping the coin, if Google's revenue share was less than 19%, Google applied a throttling probability to determine whether it would throttle the transaction, wherein the probability was determined by the following equation:[710]

[redacted]

265. [redacted].

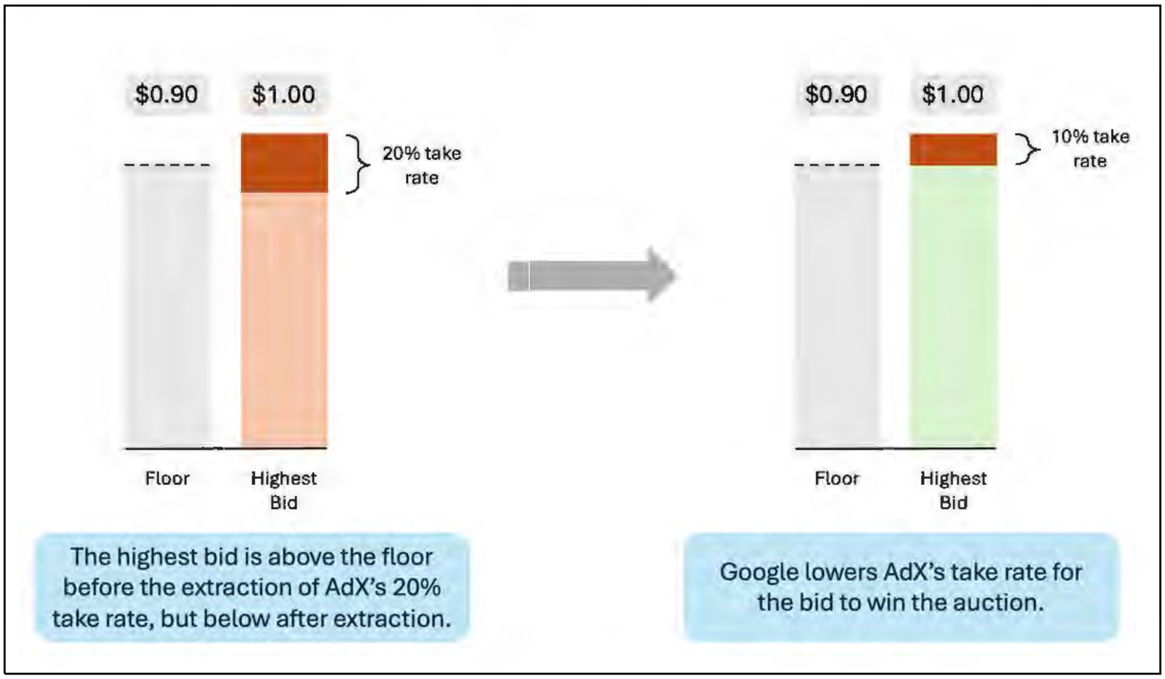
266. If Google determined that a query should be throttled, it did not transact the query.[712]

267. DRS v1 worked by lowering AdX's revenue share such that a bid that would otherwise not beat the floor price after accounting for a higher revenue share would now beat the floor with a lower revenue share applied. For example, as shown in Figure 37 if the highest bid in an auction with a $0.90 floor was $1.00, the bid could not win the auction since AdX took $0.20 as its revenue share, and the value of the bid was then $0.80. In this example, Google would use the

[707] Google document, "Dynamic Sell-Side Revshare," GOOG-NE-13202025 at '035-036 (HCI); Google document, "Dynamic Revenue Sharing: V1 and V2," GOOG-AT-MDL-001629019 at '027-038 (CI).
[708] Google document, "Dynamic Sell-Side Revshare," GOOG-NE-13202025 at '035-036 (HCI); Google document, "Dynamic Revenue Sharing: V1 and V2," GOOG-AT-MDL-001629019 at '027-038 (CI).
[709] Google document, "Dynamic Sell-Side Revshare," GOOG-NE-13202025 at '035-036 (HCI); Google document, "Dynamic Revenue Sharing: V1 and V2," GOOG-AT-MDL-001629019 at '027-038 (CI).
[710] Google document, "Dynamic Sell-Side Revshare," GOOG-NE-13202025 at '035-036 (HCI); Google document, "Dynamic Revenue Sharing: V1 and V2," GOOG-AT-MDL-001629019 at '027-038 (CI).
[711] Google document, "Dynamic Sell-Side Revshare," GOOG-NE-13202025 at '035-036 (HCI); Google document, "Dynamic Revenue Sharing: V1 and V2," GOOG-AT-MDL-001629019 at '027-038 (CI).
[712] Google document, "Dynamic Sell-Side Revshare," GOOG-NE-13202025 at '035-036 (HCI).

DRS v1 program to take a 10% revenue share from this bid instead of 20%, so the final bid value of $0.90 could exceed the floor price and win the auction.[713]

Figure 37: DRS v1 was used to lower the AdX take rate and cause a bid to win the auction[714]



268. If DRS v1 was applied to a bid, the advertiser was charged the original value of their bid.[715] As discussed in Sections B and A, AdX auctions were modified second-price prior to 2019, which meant that if the highest bid was above the floor after the deduction of Google's take rate, but the second highest bid was below the floor, the advertiser would be charged the value of the floor plus the take rate.[716] However, if DRS was applied to a bid, the advertiser always paid the value of their bid.[717] For example, in an auction with a $0.90 floor, if the highest advertiser bid was $1.00 and DRS was applied, the advertiser paid $1.00. However, if the advertiser had bid $1.50, enough to

[713] Google internal document, "AdX dynamic sell-side revenue share (DRS v1) – project description / Mini PRD," GOOG-AT-MDL-009013303 at '303 (HCI); Google internal document, "Display Ads Research (Part II)," GOOG-AT-MDL-B-001628818 at '833 (CI).
[714] Google internal document, "AdX dynamic sell-side revenue share (DRS v1) – project description / Mini PRD," GOOG-AT-MDL-009013303 at '303 (HCI); Google internal document, "Display Ads Research (Part II)," GOOG-AT-MDL-B-001628818 at '833 (CI).
[715] Google internal document, "Remove First Pricing in Sell-Side Dynamic Revshare," GOOG-NE-13204977 at '978 (HCI).
[716] Previously, when I discussed second- and first-price auction dynamics in Section III.B, all bids and the floor are assumed to be post-AdX take rate. In this section, we assume all bids and floor are pre-AdX take rate to explain the functionality of DRS.
[717] Google internal document, "Remove First Pricing in Sell-Side Dynamic Revshare," GOOG-NE-13204977 at '978 (HCI).

clear the floor without DRS, they would have paid the value of the floor, $0.90, plus the take rate, assuming that the second-highest bid in the auction is below the floor. DRS v1 determined how to adjust the revenue share after seeing the submitted bids.[718]

C. DRS v2 lowers and raises AdX's take rate to recoup lost revenue

269. DRS v2 was launched in December 2016 and allowed Google to raise the AdX take rate to counterbalance the auctions in which the take rate was lowered by DRS.[719] Since DRS v1 could only lower the AdX take rate, Google's average margin for AdX was reduced below 20%.[720] With DRS v2, if a winning bid was sufficiently above the floor, AdX would increase its revenue share above 20% to maintain a 20% revenue share on average for each publisher.[721] As with DRS v1, DRS v2 determined the AdX revenue share after seeing the bids.[722]

270. [redacted]

718 [redacted] Deposition, (April 19, 2024) at 231:10-16.
719 Google internal email, (May 28, 2016) GOOG-DOJ-14718539 at '539 (HCI); Google's First Amended Responses and Objections to Plaintiff's Third Set of Interrogatories, (May 24, 2024) at 12.
720 Google internal email, (May 28, 2016) GOOG-DOJ-14718539 at '539 (HCI).; [redacted] Deposition, (April 19, 2024) at 235:6-236:5.
721 Google internal document, "AdX Dynamic Revshare v2: Launch Doc," GOOG-NE-13207241 at '245 (HCI).
722 [redacted] Deposition, (April 19, 2024) at 231:17-22.
723 Google internal document, "AdX Dynamic Revshare v2: Launch Doc," GOOG-NE-13207241 at '245 (HCI).
724 Google internal document, "AdX Dynamic Revshare v2: Launch Doc," GOOG-NE-13207241 at '245 (HCI).
725 Google internal document, "AdX Dynamic Revshare v2: Launch Doc," GOOG-NE-13207241 at '245 (HCI).
726 Google internal document, "AdX Dynamic Revshare v2: Launch Doc," GOOG-NE-13207241 at '245 (HCI).
727 Google internal document, "AdX Dynamic Revshare v2: Launch Doc," GOOG-NE-13207241 at '245 (HCI).

[redacted]

271. [redacted]

272. [redacted]

[728] Google internal document, "AdX Dynamic Revshare v2: Launch Doc," GOOG-NE-13207241 at '245 (HCI).
[729] Google internal document, "AdX Dynamic Revshare v2: Launch Doc," GOOG-NE-13207241 at '245 (HCI).
[730] Google internal document, "AdX Dynamic Revshare v2: Launch Doc," GOOG-NE-13207241 at '245 (HCI).
[731] Google internal document, "AdX Dynamic Revshare v2: Launch Doc," GOOG-NE-13207241 at '246 (HCI).
[732] Google internal document, "AdX Dynamic Revshare v2: Launch Doc," GOOG-NE-13207241 at '246 (HCI).
[733] Google internal document, "Dynamic Revenue Sharing: V1 and V2," GOOG-AT-MDL-001629019 at 046-052 (CI).
[734] Google internal document, "AdX Dynamic Revshare v2: Launch Doc," GOOG-NE-13207241 at '245 (HCI).

[redacted]

273. [redacted]

[735] Google internal document, "Dynamic Revenue Sharing: V1 and V2," GOOG-AT-MDL-B-001629019 at '023 (CI).
[736] Google internal document, "AdX Dynamic Revshare v2: Launch Doc," GOOG-NE-13207241 at '245 (HCI).
[737] Google internal document, "AdX Dynamic Revshare v2: Launch Doc," GOOG-NE-13207241 at '245 (HCI).
[738] This example assumes that this publisher is the same as in the previous example.
[739] Google internal document, "AdX Dynamic Revshare v2: Launch Doc," GOOG-NE-13207241 at '246 (HCI).
[740] Google internal document, "AdX Dynamic Revshare v2: Launch Doc," GOOG-NE-13207241 at '246 (HCI).
[741] Google internal document, "AdX Dynamic Revshare v2: Launch Doc," GOOG-NE-13207241 at '246 (HCI).

[redacted]

274. [redacted]

[redacted] Google internal document, “AdX Dynamic Revshare v2: Launch Doc,” GOOG-NE-13207241 at ‘246 (HCI).

[743] Google internal document, “AdX Dynamic Revshare v2: Launch Doc,” GOOG-NE-13207241 at ‘246 (HCI).

[744] Google internal document, “AdX Dynamic Revshare v2: Launch Doc,” GOOG-NE-13207241 at ‘246 (HCI).

[745] Google internal document, “AdX Dynamic Revshare v2: Launch Doc,” GOOG-NE-13207241 at ‘246 (HCI).

[746] Google internal document, “AdX Dynamic Revshare v2: Launch Doc,” GOOG-NE-13207241 at ‘246 (HCI).

[747] Google internal document, “AdX Dynamic Revshare v2: Launch Doc,” GOOG-NE-13207241 at ‘246 (HCI).

[748] Google internal document, “AdX Dynamic Revshare v2: Launch Doc,” GOOG-NE-13207241 at ‘246 (HCI).

[redacted]

D. Truthful DRS (tDRS) modified AdX's take rate based on a predictive model

275. tDRS was launched in July 2018 and used a machine learning model to predict the AdX revenue share that was necessary for the highest bid to clear the auction.[750] This version of DRS was implemented because the first two versions of DRS incentivized bidders to bid strategically, knowing that DRS was operating in AdX, instead of truthfully bidding what they were willing to pay.[751] Bids from Google's buyside products, Google Ads and DV360, were included in this version of DRS.[752] When tDRS was launched, DRS v2 was deactivated.[753]

276. [redacted]

[749] Google internal document, "AdX Dynamic Revshare v2: Launch Doc," GOOG-NE-13207241 at '246 (HCI).
[750] Google internal email, (September 29, 2017) GOOG-AT-MDL-B-003131145 at '145 (CI); Google internal document, "Truthful DRS Design Doc," GOOG-NE-13226622 at '622 (HCI); [redacted] Deposition, (April 19, 2024) at 290:9-20.; Google's First Amended Responses and Objections to Plaintiff's Third Set of Interrogatories, (May 24, 2024) at 12.
[751] Google internal document, "Truthful DRS Design Doc," GOOG-NE-13226622 at '622 (HCI).
[752] Google internal document, "Make AdX Dynamic Revshare Truthful," GOOG-DOJ-AT-02426129 at '131 (HCI).
[753] [redacted] Deposition, (April 19, 2024) at 334:14-22.

[redacted]

277. [redacted]

278. [redacted][762]

[754] Google internal document, "Make AdX Dynamic Revshare Truthful," GOOG-DOJ-AT-02426129 at '129-130 (HCI).
[755] Google internal document, "Make AdX Dynamic Revshare Truthful," GOOG-DOJ-AT-02426129 at '129-130 (HCI).
[756] Google internal document, "Make AdX Dynamic Revshare Truthful," GOOG-DOJ-AT-02426129 at '129-130 (HCI).
[757] Google internal document, "Make AdX Dynamic Revshare Truthful," GOOG-DOJ-AT-02426129 at '129-130 (HCI).
[758] Google internal document, "Make AdX Dynamic Revshare Truthful," GOOG-DOJ-AT-02426129 at '129-130 (HCI).
[759] Google internal document, "Make AdX Dynamic Revshare Truthful," GOOG-DOJ-AT-02426129 at '129-130 (HCI).
[760] Google internal document, "Make AdX Dynamic Revshare Truthful," GOOG-DOJ-AT-02426129 at '129-130 (HCI).
[761] Google internal document, "Make AdX Dynamic Revshare Truthful," GOOG-DOJ-AT-02426129 at '129-130 (HCI).
[762] Based on the example in Google internal document, "Make AdX Dynamic Revshare Truthful," GOOG-DOJ-AT-02426129 at '129-130 (HCI).

[redacted]

279. [redacted]

280. I understand that tDRS was turned off in September 2019 when Google implemented a first-price auction on AdX.[767]

XII. GOOGLE IMPLEMENTS PROJECT POIROT TO REDUCE THE AMOUNT DV360 SPENDS ON SECOND-PRICE EXCHANGES WITH SOFT FLOORS

281. Project Poirot was launched on June 19, 2017, to reduce DV360's bids in second-price exchanges with "soft" floors.[768] Project Poirot was applied to every exchange.[769] As previously stated in Section B, auctions can be first or second-price. According to Google, some exchanges run a second-price auction where they allow bids below the floor to win the auction, resulting in a "soft" floor.[770] For example, an exchange may have a soft floor of $10 and a real floor of $8, which means that the floor sent in the bid request is $10; however, if a bid is above $8 it can still win the auction. Google uses Project Poirot to "detect and quantify deviations from second price-auctions" and has DV360 bid less in those exchanges. Advertisers may opt-out of Project Poirot in the DV360 interface.[771] As with Bernanke, Project Poirot took place after DV360 ran its auction, but before the bid was submitted to AdX.[772] Specifically, the Poirot experiment file was read and

763 A logistic regression model is a statistical method to produce a binary outcome.
764 Google internal document, "Truthful DRS Design Doc," GOOG-NE-13226622 at '623 (HCI).
765 Google internal document, "Truthful DRS Design Doc," GOOG-NE-13226622 at '623 (HCI); [redacted] Deposition, (April 19, 2024) at 292:17-20.
766 Google internal document, "Truthful DRS Design Doc," GOOG-NE-13226622 at '624 (HCI).
767 [redacted] Deposition, (April 19, 2024) at 334:2-13, 335:4-24.
768 Google's First Amended Responses and Objections to Plaintiff's Third Set of Interrogatories, (May 24, 2024) at 12.; Google internal email, GOOG-NE-13558460 at '460 (HCI); Google introduced several updates to Project Poirot, the goal of this section is to describe the general purpose and function of the project.
769 [redacted] Deposition, (April 26, 2024) at 246:22-247:2.
770 Google internal document, "Bidding in adversarial auctions," GOOG-NE-05279363 at '373 (HCI).
771 Google internal email, GOOG-NE-13558460 at '460 (HCI).
772 [redacted] Deposition, (May 21, 2024) at 395:20-10.

applied as part of the bid adjustment in the bid computation as part of the auction preparation CAT2 Mixer.[773]

282. The amount that bids are lowered by Project Poirot is determined by a machine learning algorithm trained on DV360 data.[774] [redacted].[776] The multiplier is generated on a per-advertiser, per-exchange basis.[777] If the value of an impression is defined as the maximum of the floor and the second highest bid, then a perfect bidding algorithm in a clean second-price auction would bid the value for each impression.[778] In this case, the surplus would be zero, since the difference between the value and the cost is zero. Zero is the maximum surplus in a clean auction since the cost is always greater than or equal to the value. However, in a second-price auction with soft floors, bidding the value is not always optimal, since bidding below the floor can still result in winning an auction. In an auction with soft floors, the surplus can be positive since the value of an impression can be below the cost, *i.e.,* a publisher can win with a cost below the floor. The Poirot experiments consist of bids with different bid reduction multipliers, referred to as "*alpha*," the results of which are used in a model that maximizes surplus and determines the optimal bid reduction multiplier.[779] Initially, *alpha* was restricted to being between [redacted].[780] [redacted] Using this algorithm Google claims that exchanges such as OpenX and Pubmatic have second-price auctions with soft floors, while AdX, United, Adaptv and other exchanges run a clean second-price auction.[782]

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[773] [redacted] Deposition, (May 21, 2024) at 441:13-21.
[774] Google internal document, "Project Poirot," (April 25, 2017) GOOG-DOJ-AT-02180605 at '607-609 (HCI); [redacted] Deposition, (May 21, 2024) at 431:12-17.
[775] [redacted] Deposition, (May 21, 2024) at 431:19-23.
[776] Google internal document, "Poirot Review," GOOG-DOJ-32261273 at '279 (CI); Google internal document, "Project Poirot," (April 25, 2017) GOOG-DOJ-AT-02180605 at '607 (HCI).
[777] [redacted] Deposition, (May 21, 2024) at 433:2-4.
[778] This abstracts away the fraction above the value that is necessary to win an auction.
[779] Google internal document, "Project Poirot," (April 25, 2017) GOOG-DOJ-AT-02180605 at '609 (HCI); [redacted] Deposition, (April 26, 2024) at 352:1-18; [redacted] Deposition, (May 21, 2024) at 379:12-17.
[780] [redacted] Deposition, (April 26, 2024) at 352:20-23.
[781] Google internal document, "Project Poirot," (April 25, 2017) GOOG-DOJ-AT-02180605 at '609 (HCI).
[782] Google internal document, "Poirot Review," GOOG-DOJ-32261273 at '280 and '282 (CI).

283. Following the initial version of Poirot, I understand that Google launched Poirot with Bid Buckets on January 8, 2018.[783] Advertisers would submit fixed CPM bids, known as "front-end bids."[784] Google would then take the front-end bids and group them into approximately [redacted] buckets of roughly even distribution consisting of bid ranges, running from small values to large values.[785] Each bucket then received a different multiplier.[786] [redacted].[787]

284. I understand that Google launched Poirot v2.0 on September 3, 2018.[788] Poirot v2.0 was also known as "Poirot with Auction Type Signal."[789] Poirot v2.0 changed the limits for *alpha* to be between [redacted].[790] Poirot v2.0 also introduced a signal to indicate an auction type signal, which was provided by exchanges to indicate whether an auction was a first-price or a second-price auction.[791] Poirot used the auction type signal to adjust the multiplier down based on the type of signal.[792] Where the auction was a true second-price auction, Poirot v2 did not adjust the multiplier.[793] Where the auction was indicated as a first-price auction, or where the auction was labelled as a second-price auction but wasn't entirely true, the multiplier was adjusted down.[794] Following Google's transition of AdX to a modified first-price auction, Poirot started reducing the bids that were submitted to AdX.[795]

285. Google launched another version of Poirot in September 2019 that incorporated minimum bid to win data provided by Google Ad Manager following Google's transition to a unified first-price auction.[796] By this point, Project Poirot was running on both DV360 and AdWords.[797]

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[783] [redacted] Deposition, (May 21, 2024) at 380:9-23; Google's First Amended Responses and Objections to Plaintiff's Third Set of Interrogatories, (May 24, 2024) at 12.
[784] [redacted] Deposition, (May 21, 2024) at 381:8-382:19.
[785] [redacted] Deposition, (May 21, 2024) at 382:20-383:16.
[786] [redacted] Deposition, (May 21, 2024) at 384:5-11.
[787] [redacted] Deposition, (May 21, 2024) at 384:13-19.
[788] Google's First Amended Responses and Objections to Plaintiff's Third Set of Interrogatories, (May 24, 2024) at 12.
[789] Google's First Amended Responses and Objections to Plaintiff's Third Set of Interrogatories, (May 24, 2024) at 12
[790] [redacted] Deposition, (May 21, 2024) at 386:10-20.
[791] [redacted] Deposition, (May 21, 2024) at 386:10-387:2.
[792] [redacted] Deposition, (May 21, 2024) at 387:19-388:18.
[793] [redacted] Deposition, (May 21, 2024) at 387:19-388:18.
[794] [redacted] Deposition, (May 21, 2024) at 387:19-388:18.
[795] [redacted] Deposition, (May 21, 2024) at 398:14-18.
[796] [redacted] Deposition, (May 21, 2024) at 394:8-395:3; Google's First Amended Responses and Objections to Plaintiff's Third Set of Interrogatories, (May 24, 2024) at 12.
[797] [redacted] Deposition, (May 21, 2024) at 394:25-395.

286. I understand that Google provided a checkbox that permitted advertisers to opt out of Project Poirot, which said "[o]ptimize my fixed bidding to help me get the best possible price for each impression."[798] I further understand that the default was that Project Poirot was enabled, and that less than one percent of advertisers opted out.[799]

287. After rolling out Project Poirot, Google launched Project Marple.[800] Project Marple applied the Project Poirot methodology to Google Ads (formerly AdWords).[801] As with Poirot, Marple also uses the past seven days of data to train the model.[802] I understand that after the unified first-price migration, both AdWords (Marple) and DV360 (Poirot) used the minimum bid to win data.[803] As with Bernanke, Marple took place after AdWords ran its auction, but before the bids were submitted to AdX.[804] I understand that Project Poirot is still running today.[805]

XIII. GOOGLE IMPLEMENTED RESERVE PRICE OPTIMIZATION TO DYNAMICALLY INCREASE ADX FLOOR PRICES

288. Reserve Price Optimization (RPO), also known as "Dynamic Reserve Price Optimization," "AdX Dynamic Price" and publicly marketed as "Optimized Pricing" is an automated feature that dynamically increases auction floors to be as close to the anticipated highest bid as possible.[806]

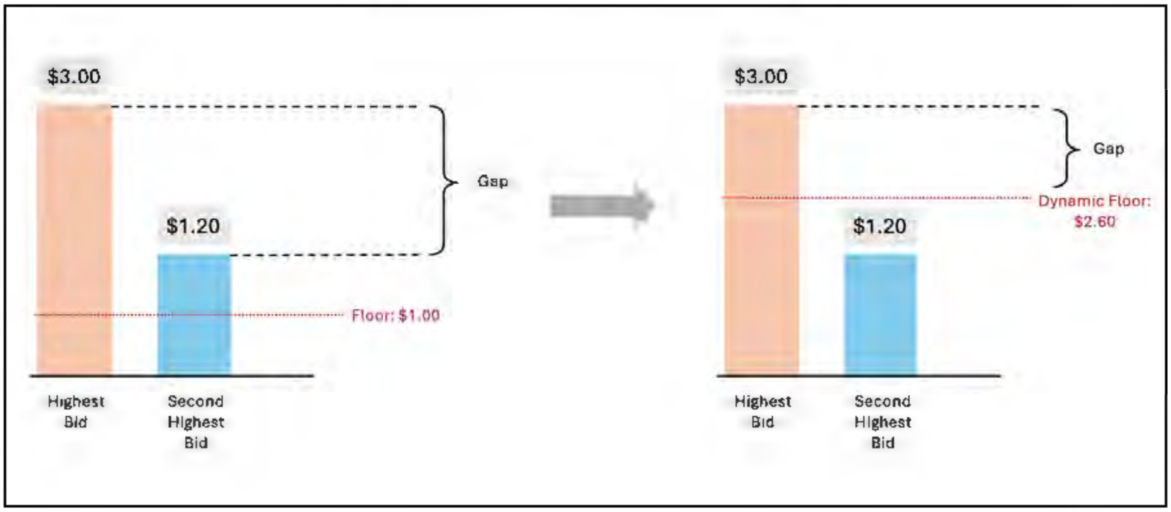
289. Google released two types of RPO: second-price RPO, which was initially launched in March of 2015 and designed for second-price auctions, and first-price RPO (fRPO), which was launched in 2022 and designed to account for the changes accompanying AdX's transition to a first-price model.[807] I explain both in detail in the following subsections.

798 [redacted] Deposition, (April 26, 2024) at 353:18-354:23.
799 [redacted] Deposition, (April 26, 2024) at 249:9-250:21.
800 [redacted] Deposition, (April 26, 2024) at 256:11-15.
801 [redacted] Deposition, (April 26, 2024) at 255:17-256:25, 396:11-15.; [redacted] Deposition, (April 26, 2024) at 257:2-6.
802 [redacted] Deposition, (May 21, 2024) at 431:25-432:5.
803 [redacted] Deposition, (May 21, 2024) at 396:17-21.
804 [redacted] Deposition, (May 21, 2024) at 395:20-10.
805 [redacted] Deposition, (April 26, 2024) at 259:16-19.
806 Google internal document, "2-Pager: RPO + OPR Commercialization," GOOG-AT-MDL-000989823 at '823-824 (HCI); [redacted] Deposition, (April 19, 2024) at 105:22-106:10.
807 Google internal document, "This document lists launches where the responsible PM is maxl@, selected from Ariane with dates after Jan 2015, and launches from DRX IAS team selected since Jan 2016," GOOG-DOJ-15435288 at '289 (HCI); Google's First Amended Responses and Objections to Plaintiff's Third Set of Interrogatories, (May 24, 2024) at 12.

A. Second-price RPO raised auction floors on a per-buyer basis using historical AdX auction data

290. The initial version of second-price RPO was released March 31, 2015, and was designed specifically for AdX.[808] When AdX functioned as a second-price auction, Google observed that there was a sizable gap between the highest bid and what the advertiser actually paid (*i.e.*, the second highest bid).[809] Google therefore aimed to minimize the gap between the two values by setting the auction floor as close to the anticipated highest bid as possible. This is illustrated in Figure 40 below.

Figure 40: Second-price RPO



291. To achieve this, Google designed a model that analyzed historical AdX auction data to predict the highest possible bid from each buyer on a given segment of inventory.[810] Google then used these statistics to derive per-buyer auction floors that maximized publisher revenue.[811]

292. [redacted]

[808] Google internal document, "AdX Dynamic Price," (August 2015) GOOG-NE-13204729 at '730 (HCI); Google's First Amended Responses and Objections to Plaintiff's Third Set of Interrogatories, (May 24, 2024) at 12.
[809] Google internal document, "AdX Dynamic Price," (August 2015) GOOG-NE-13204729 at '732-733 (HCI).
[810] Google internal document, "AdX Dynamic Price," (August 2015) GOOG-NE-13204729 at '734 (HCI).
[811] Google internal document, "AdX Per Buyer Reserve Prices," (October 2014) GOOG-AT-MDL-009012677 at '677 (HCI).

[redacted]

[redacted].[818]

294. Google subsequently released several additional iterations of RPO. In October of 2015, Google released cookie-based RPO, where in addition to making predictions based on the inventory unit and the buyer, Google started incorporating cookie information.[819] According to Google, buyers often buy impressions based on cookies, rendering them important for the

[812] Google internal document, "AdX Per Buyer Reserve Prices," (October 2014) GOOG-AT-MDL-009012677 at '678 (HCI); Google internal document, "AdX Dynamic Price," (August 2015) GOOG-NE-13204729 at '746 (HCI).
[813] Google internal document, "AdX Per Buyer Reserve Prices," (October 2014) GOOG-AT-MDL-009012677 at '677 (HCI); Google internal document, "AdX Dynamic Price," (August 2015) GOOG-NE-13204729 at '746 (HCI).
[814] Google internal document, "AdX Dynamic Price," (August 2015) GOOG-NE-13204729 at '746 (HCI).
[815] Google internal document, "AdX Per Buyer Reserve Prices," (October 2014) GOOG-AT-MDL-009012677 at '678-679 (HCI); Google internal document, "AdX Dynamic Price," (August 2015) GOOG-NE-13204729 at '746 (HCI).
[816] Google internal document, "AdX Per Buyer Reserve Prices," (October 2014) GOOG-AT-MDL-009012677 at '680 (HCI); Google internal document, "AdX Dynamic Price," (August 2015) GOOG-NE-13204729 at '746 (HCI).
[817] Google internal document, "AdX Dynamic Price," (August 2015) GOOG-NE-13204729 at '741 (HCI).
[818] Google internal document, "AdX Per Buyer Reserve Prices," (October 2014) GOOG-AT-MDL-009012677 at '680 (HCI); Google internal document, "AdX Dynamic Price Models in MLT," (May 2015) GOOG-NE-13208126 at '127 (HCI).
[819] Google internal document, "Cookie based Dynamic Reserve Price Optimization (RPO) – mini PRD," GOOG-DOJ-AT-02320070 at '070 (HCI); Google internal document, "This document lists launches where the responsible PM is maxl@, selected from Ariane with dates after Jan 2015, and launches from DRX IAS team selected since Jan 2016," GOOG-DOJ-15435288 at '289 (HCI).

valuation of publisher inventory.[820] For example, someone located in Dallas, Texas who is interested in finance websites probably correlates to someone with higher net worth, therefore a more expensive brand may be interested in serving an ad. The more information you have the finer the targeting becomes.[821] As such, Google started incorporating cookies as an additional dimension into the pricing model such that a different reserve price was calculated and applied to each query based on the individual buying tool and the cookie. [redacted]

295. [redacted] er

[820] Google internal document, "Cookie based Dynamic Reserve Price Optimization (RPO) – mini PRD," GOOG-DOJ-AT-02320070 at '070 (HCI).
[821] Conversation with Professor Chandler, June 6, 2024.
[822] Google internal document, "Status: Code change Launched (cl/148248152). Experiment in serving with Biscotti Carveout at 1%," (May 2016) GOOG-NE-13217060 at '060 (HCI); Google internal document, "AdX Dynamic Price Models in MLT," (May 2015) GOOG-NE-13208126 at '127 (HCI).
[823] Google internal document, "Status: Code change Launched (cl/148248152). Experiment in serving with Biscotti Carveout at 1%," (May 2016) GOOG-NE-13217060 at '060 (HCI).
[824] Google internal document, "Dynamic Reserve Price Optimization Modeling Design," (January 2017) GOOG-AT-MDL-012683798 at '798 (CI). Note that according to other Google internal documents, this was subject to change. *See* Google internal document, "Optimized Pricing in the Open Auction Comms," (May 2016) GOOG-AT-MDL-001391101 at '108 (CI).
[825] Google internal document, "AdX Dynamic Price Models in MLT," (May 2015) GOOG-NE-13208126 at '127 (HCI).

[redacted]

296. [redacted]

[redacted]

297. [redacted]

826 Google internal document, "Status: Code change Launched (cl/148248152). Experiment in serving with Biscotti Carveout at 1%," (May 2016) GOOG-NE-13217060 at '061 (HCI); Google internal document, "Dynamic Reserve Price Optimization Modeling Design," (January 2017) GOOG-AT-MDL-012683798 at '799 (CI).

827 Google internal document, "Status: Code change Launched (cl/148248152). Experiment in serving with Biscotti Carveout at 1%," (May 2016) GOOG-NE-13217060 at '061 (HCI).

828 This example has been synthesized from an internal Google document. *See* Google internal document, "AdX Dynamic Price Models in MLT," (May 2015) GOOG-NE-13208126 at '127-128 (HCI).

[redacted]

298. [redacted]

299. [redacted]

829 Google internal document, "Dynamic Reserve Price Optimization Modeling Design," (January 2017) GOOG-AT-MDL-012683798 at '799 (CI); Google internal document, "AdX Dynamic Price," (August 2015) GOOG-NE-13204729 at '748 (HCI).

830 Google internal document, "AdX Dynamic Price Models in MLT," (May 2015) GOOG-NE-13208126 at '131 (HCI).

831 Google internal document, "go/rpo-exemption-policy-v2," (December 2017) GOOG-DOJ-28486313 at '313-314 (CI).

832 Google internal document, "AdX Auction Optimizations," GOOG-NE-06842715 at '727 (HCI); Google internal document, "Optimized Pricing in the Open Auction Comms," (May 2016) GOOG-AT-MDL-001391101 at '104 (CI).

833 Google internal document, "This document lists launches where the responsible PM is maxl@, selected from Ariane with dates after Jan 2015, and launches from DRX IAS team selected since Jan 2016," GOOG-DOJ-15435288 at '289 (CI).

834 Google internal document, "AdX Dynamic Price: QEM Inventory Model Launch," (March 2016) GOOG-DOJ-AT-02421480 at '480 (HCI).

835 Google internal document, "Optimized Pricing in the Open Auction Comms," (May 2016) GOOG-AT-MDL-001391101 at '109 (CI); Google internal document, "Ad Manager Ecosystem 101," GOOG-DOJ-AT-02199478 at '526 (HCI).

836 Google internal document, "AdX Managed Reserves," GOOG-AT-MDL-019716988 at '988 (CI); Google internal document, "AdX Dynamic Price QEM Inventory Model," (March 2016) GOOG-AT-MDL-B-002862417 at '419 (CI).

300. [redacted]

B. First-price RPO raised auction floors uniformly across buyers based on historical AdX auction data

301. When AdX switched to a first-price auction, buyer behavior and therefore the technique for estimating floors changed. In a first-price auction, buyers are no longer incentivized to bid their true value and instead lower their bids to maximize utility. Further, winning buyers are incentivized to lower their bids over time in order to reduce the amount they have to pay to win. This is commonly referred to as bid shading.[840] The new version of RPO, first-price RPO (fRPO), therefore aimed to dynamically increase auction floors to prevent advertisers from lowering their bids.[841] Google identified rough criteria for a potential fRPO launch; namely fRPO must: treat every buyer equally, apply everywhere UPR applies, not decrease publisher revenue, increase RPI, and not hurt remnant revenue (especially from Header Bidding).[842]

302. [redacted]

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837 Google internal document, "go/rpo-exemption-policy-v2," (December 2017) GOOG-DOJ-28486313 at '313-'314 (CI); Google internal document, "Proposed way to simply describe the new auction dynamics (option 2 from go/jedi-auction-dynamics)," GOOG-TEX-00983966 at '966 (HCI).
838 Google internal document, "Optimized Pricing in the Open Auction Comms," (May 2016) GOOG-AT-MDL-001391101 at '107 and '110 (CI).
839 Google's First Amended Responses and Objections to Plaintiff's Third Set of Interrogatories, (May 24, 2024) at 12.
840 Weinberg Report, para. 48; [redacted] Deposition, (April 19, 2024) at 177:7-178:13.
841 Google internal document, "Sellside Launch Doc: First-Price Reserve Price Optimization," GOOG-AT-MDL-001971579 at '579 (HCI); [redacted] Deposition, (April 19, 2024) at 111:7-21.
842 Google internal document, "Discussion: RPO Path to Launch," GOOG-AT-MDL-001963256 at '256 (HCI).
843 Google internal document, "Sellside Launch Doc: First-Price Reserve Price Optimization," GOOG-AT-MDL-001971579 at '581 (HCI).

[redacted]

303. [redacted]

[redacted]

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[844] Google internal document, “Sellside Launch Doc: First-Price Reserve Price Optimization,” GOOG-AT-MDL-001971579 at ‘581 (HCI).
[845] Google internal document, “Sellside Launch Doc: First-Price Reserve Price Optimization,” GOOG-AT-MDL-001971579 at ‘581 (HCI).
[846] Google internal document, “Sellside Launch Doc: First-Price Reserve Price Optimization,” GOOG-AT-MDL-001971579 at ‘582 (HCI).
[847] Google internal document, “Sellside Launch Doc: First-Price Reserve Price Optimization,” GOOG-AT-MDL-001971579 at ‘586 (HCI).
[848] Google internal document, “Estimating Buyer Reaction to Dynamic Reserve Prices,” GOOG-AT-MDL-004016998 at ‘999 (HCI); [redacted] Deposition, (April 19, 2024) at 251:15-252:17.

[redacted]

305. First-price RPO was launched on limited traffic in June 2022.[851] Initially designed for Ad Manager's first-price auction on select web traffic, fRPO was extended to all web traffic in January 2023.[852] Unlike second-price RPO, first-price RPO is an optional feature and can be disabled in GAM network settings.[853]

XIV. UNIFIED PRICING RULES ENFORCE UNIFORM PRICE FLOORS ACROSS COMPETING EXCHANGES

306. Unified Pricing Rules (UPR), introduced by Google around May 2019 in an open beta,[854] is a feature within the GAM interface that enables publishers to set uniform pricing rules for a given segment of their inventory, which apply across all indirect demand sources, including AdX, Exchange Bidding participants and all remnant line items. UPR fully launched on September 25, 2019 and was contemporaneous with Google's transition to a unified first-price auction.[855]

A. Prior to UPR, publishers were able to set custom per-exchange floors and per-buyer tool floors

307. Prior to UPR, GAM ran a multistage auction where multiple exchanges competed with one another. Each exchange could have its own designated price floor, which was configured by the publisher through the exchange's interface.[856]

308. In addition to setting price floors on third-party exchanges, publishers using GAM could set price floors for each buying tool, advertiser, and other segments of inventory. Prior to UPR,

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849 Google internal document, "Estimating Buyer Reaction to Dynamic Reserve Prices," GOOG-AT-MDL-004016998 at '999 (HCI).
850 Google internal document, "Estimating Buyer Reaction to Dynamic Reserve Prices," GOOG-AT-MDL-004016998 at '004 (HCI).
851 Google internal document, "1-Pager: RPO Launch Checklist," GOOG-AT-MDL-013262396 at '396 (HCI); Google's First Amended Responses and Objections to Plaintiff's Third Set of Interrogatories, (May 24, 2024) at 12.
852 Google internal workbook, "Launch ID 4125765 Details," GOOG-AT-MDL-009644380 (HCI); Google's First Amended Responses and Objections to Plaintiff's Third Set of Interrogatories, (May 24, 2024) at 12; [redacted] Deposition, (April 19, 2024) at 279:10-21.
853 Google Ad Manager Help, "Optimize pricing to reflect inventory's value," https://support.google.com/admanager/answer/12243638?hl=en. Accessed June 7, 2024.
854 Google's First Amended Responses and Objections to Plaintiff's Third Set of Interrogatories, (May 24, 2024) at 12
855 Google's First Amended Responses and Objections to Plaintiff's Third Set of Interrogatories, (May 24, 2024) at 12; Google internal document, "1st Price Migration," GOOG-DOJ-28243636 at '637 (CI).
856 "Declaration of [redacted]," (August 4, 2023) GOOG-AT-MDL-008842393 at '405-406 (HCI); [redacted] Deposition, (May 24, 2024) at 658:17-660:11.

publishers could configure price floors for AdX through the "Open Auction Pricing Rules" interface within GAM. Each pricing rule specified a price floor for a particular portion of publisher inventory and could either be applied to all buyers or select advertisers, brands, and buying tools (including Google Ads, DV360, and Authorized Buyers).[857] There were three threshold types that publishers could choose from to set auction floors for a given segment of inventory:

1) Fixed CPM. With a fixed CPM, bids for the inventory were bound by a fixed floor set by the publisher.

Target CPM.[858] Target CPM specifies the minimum average CPM floor that a segment of inventory should meet averaged across multiple queries. In other words, it allows individual CPM floors on a given segment of inventory to vary (*i.e.*, be higher or lower than the target value) across several impressions if, on average, the floor is greater than or equal to the specified target value. For example, if a slice of inventory has a target CPM of $2.00, it may have floors of $1.50 and $2.50 for two separate impressions that fall under the pricing rule, for an average of $2.00. Google's target CPM model determines the optimal floor for the auction that maximizes publisher yield, while maintaining the target floor on average. Target CPM was available through Open Auction and DFP pricing rules prior to UPR.[859]

3) Managed Reserves (MR).[860] If a publisher enabled Managed Reserves on a given piece of inventory, it would override any floor configured by the publisher and was not bound by any constraints.[861] This feature was created to maximize overall publisher revenue and set new floors based on optimization calculations leveraging historical bid data.[862]

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857 Incubeta DQ&A, "DQ&A Webinar: Google Ad Exchange Ad Manager 360 [Advanced]" (May 3, 2019) https://www.youtube.com/watch?v=UpXq66ME1gQ at 5:07; "Declaration of [redacted]," (August 4, 2023) GOOG-AT-MDL-008842393 at '405 (HCI); Google internal document, "1st Price Auction: Unified Pricing Rules," GOOG-AT-MDL-000993900 at '916 (CI).
858 Google states that there is a small number of cases where they cannot match the target CPM, such as when the "rule is new and/or doesn't have enough data for full optimization" or when there is "significant fluctuation in the inventory traffic." Google Ad Manager Help, "Target CPM," https://support.google.com/admanager/answer/10357452?hl=en. Accessed June 7, 2024; See Appendix C Section B.31 for findings from my analysis of Google's source code on the training pipeline of Target CPM and Managed Reserves models.
859 Google internal document, "Yield Management in Google Ad Manager," (November 2018) GOOG-DOJ-AT-02134358 at '367 (HCI).
860 See Appendix C Section B.31 for findings from my analysis of Google's source code on the training pipeline of Target CPM and Managed Reserves models.
861 Google internal document, "Yield Management in Google Ad Manager," (November 2018) GOOG-DOJ-AT-02134358 at '367 (HCI).
862 Google internal document, "Yield Management in Google Ad Manager," (November 2018) GOOG-AT-MDL-000993483 at '510 (HCI).

309. Publishers could also assign a priority number for each rule in GAM, dictating which rule takes precedence in cases where two or more pricing rules overlap in inventory: the rule from the higher priority would apply to the available demand.[863] For third-party exchanges participating in Header Bidding and Exchange Bidding, publishers could similarly set custom floors through their Header Bidding setup or each third-party exchange's interface, respectively.[864]

310. Additionally, publishers had access to different "branding types," which controlled the amount of information about the webpage the user was visiting that was shared with buyers, to further customize their pricing rules. Prior to UPR, publishers could choose from three branding types: Branded, where the buyer would receive the full URL of the webpage being visited (*e.g.*, www.wsj.com/finance); Semi-Transparent, where the buyer would only receive the domain (*e.g.*, www.wsj.com); and Anonymous, where the buyer would receive no information.[865]

311. However, prior to UPR publishers could not use GAM to configure price floors for third-party exchanges bidding through Exchange Bidding, Header Bidding, or other channels.[866] Instead, as discussed above, publishers would set price floors for third-party exchanges through an interface provided by the exchange.

312. Once an impression became available on a publisher website:

1) If the publisher had a Header Bidding tag, the Header Bidding auction ran first. Winning bids were sent to DFP and generally matched to remnant line items, as described in Section VIII.

[863] Google internal document, "The Unified First Price Auction," (August 2019) GOOG-AT-MDL-000875073 at '083 (HCI).
[864] "[Prior to UPR] publishers had to undertake the complex and time-consuming task of configuring price floors separately on each exchange and network where their inventory was available." "Declaration of [redacted]," (August 4, 2023) GOOG-AT-MDL-008842393 at '405 (HCI). For Header Bidding wrappers such as Prebid.js, publishers could specify price floors at the ad unit level. Prebid, "Price Floors Module," https://docs.prebid.org/dev-docs/modules/floors.html. Accessed June 7, 2024. Each ad unit in Prebid would specify the demand partners that could bid for that ad unit, so when Prebid requested bids from these demand partners the floor price would be passed as well. Prebid, "Ad Unit Reference," https://docs.prebid.org/dev-docs/adunit-reference.html. Accessed May 23, 2024.
[865] Google internal document, "The Unified First Price Auction," (August 2019) GOOG-AT-MDL-000875073 at '083 (HCI); [redacted] Deposition, (May 24, 2024) at 652:24-654:10.
[866] "Declaration of [redacted]," (August 4, 2023) GOOG-AT-MDL-008842393 at '405 (HCI); [redacted] Deposition, (May 24, 2024) at 658:17-660:11.

2) GAM invoked one or more of the following features where applicable, which worked together to inform the price floor for AdX, and in some cases, for other indirect demand:[867]

i. As described in Section VII, GAM invoked Enhanced Dynamic Allocation (EDA), an automated feature enabled by default and not controlled by publishers, to calculate the best guaranteed line item based on line item priority and delivery schedule, and calculated a temporary CPM (tCPM) for it. In addition to tCPM, this value is often referred to as EDA CPM, EDA price or Ad Manager Reserve Price.[868]

ii. GAM then selected the remnant line item with the highest value CPM (vCPM), which informed the auction floor as well. The act of using the remnant line item with the highest vCPM to inform the auction floor was internally referred to as "Last Look," as discussed in Section VII.B. In some internal documents, the maximum of tCPM calculated in the step above and vCPM calculated in this step was referred to as "third-party min CPM."[869]

iii. If the guaranteed line item selected by GAM in step (i) was a Standard line item and the publisher opted into Optimized Competition (OC), a feature designed to lower excessively high EDA prices that are difficult to meet for even the highest bidders, DFP calculated the "OC floor." [870] [redacted]

[867] Google internal document, "Yield Management in Google Ad Manager," (November 2018) GOOG-DOJ-AT-02134358 at '362 (HCI).
[868] Google internal document, "Reservation & Auction Dynamics," GOOG-AT-MDL-004291695 at '707 (CI); Google internal document, "Yield Management in Google Ad Manager," (November 2018) GOOG-AT-MDL-000993483 at '493 (HCI); Google internal document, "Ad Manager Ecosystem 101," GOOG-DOJ-AT-02199478 at '505 (HCI).
[869] Google internal document, "go/rpo-exemption-policy," (December 2017) GOOG-DOJ-28486313 at '314 (CI).
[870] Google internal document, "Yield Management in Google Ad Manager," (November 2018) GOOG-AT-MDL-000993483 at '491, '493 (HCI); Google internal document, "Ad Manager Ecosystem 101," GOOG-DOJ-AT-02199478 at '522 (HCI).
[871] Google internal document, "Yield Management in Google Ad Manager," (November 2018) GOOG-AT-MDL-000993483 at '491, '493 (HCI).

[redacted]

iv. If the publisher opted into DFP First Look (DFL), which allowed to define custom price floors on distinct segments of inventory for select buyers, GAM incorporated the publisher-configured DFL floor into the final floor calculation.[873] DFL is intended to give buyers an ability to have a "first look" at publisher-selected impressions before other campaigns.[874] Note that DFL is only activated when the highest AdX bid is less than the EDA CPM, and if activated, takes precedence over both EDA and OC floors calculated in Steps (i) and (iii).[875] In other words, a first look bid can still win if it is below the EDA price.

v. GAM invoked second-price Reserve Price Optimization (2P RPO), also known as "Optimized Pricing" and "AdX Dynamic Price,"[876] which was a no opt-out feature that increased floors that Google considered were too low in comparison to what the buyers were willing to pay, as discussed in detail in Section XIII.A.[877] To reiterate, RPO could only increase the publisher-set auction floor and applied to AdX and AdSense publishers.[878]

3) Auction floors were set.

i. The per-buyer AdX floor prices were set to be the maximum of third-party CPM threshold, DFL, second-price RPO, publisher-configured AdX floor and a

872 Google internal document, "Yield Management in Google Ad Manager," (November 2018) GOOG-AT-MDL-000993483 at '491, '493 (HCI).
873 By default, DFL is opted out of competing with Sponsorship guaranteed line items, though publishers can manually enable this option via network settings if they wish. Google internal document, "Yield Management in Google Ad Manager," (November 2018) GOOG-AT-MDL-000993483 at '495 (HCI).
874 Google internal document, "Ad Manager Ecosystem 101," GOOG-DOJ-AT-02199478 at '516 (HCI); [redacted] Deposition, (April 26, 2024) at 77:7-13.
875 Google internal document, "Reservation & Auction Dynamics," GOOG-AT-MDL-004291695 at '700 (CI); Google internal document, "Yield Management in Google Ad Manager," (November 2018) GOOG-AT-MDL-000993483 at '495 (HCI).
876 Google internal document, "Optimized Pricing in the Open Auction Comms," (May 2016) GOOG-AT-MDL-001391101 at '101 (CI).
877 Google internal document, "Optimized Pricing in the Open Auction Comms," (May 2016) GOOG-AT-MDL-001391101 at '103, '107 (CI).
878 Google internal document, "Reservation & Auction Dynamics," GOOG-AT-MDL-000993483 at '505 (HCI). As a reminder, buyers who were second pricing themselves in their bid requests were exempt from RPO. See Google internal document, "go/rpo-exemption-policy," (December 2017) GOOG-DOJ-28486313 at '314 (CI).

global minimum CPM equal to [redacted], which was used to ensure no impressions are served for free.[879]

ii. While Exchange Bidding participants were exempt from AdX Open Auction Pricing Rules, they were subject to the third-party CPM threshold and a global minimum CPM threshold enforced by GAM.[880] They could also each be bound by their own publisher-configured floors.

4) GAM called AdX to run an auction.

i. AdX targeting servers constructed bid requests storing the floor calculated in step 3.(i) and passed them to buyers.

ii. AdX performed auction filtering comparing the per-buyer floors to the bids received to decide the eligibility of the candidate to proceed in the auction process.[881]

iii. AdX ran a second-price auction among the surviving candidates and selected the winner. The AdX clearing price was calculated.[882]

5) The AdX clearing price was submitted to a "unified auction" to compete with Exchange Bidding buyers and remnant line items on a first-price basis.

6) The highest bidder won the unified auction and the winning ad was served on the publisher website.

7) If no winner was selected, the ad slot was filled with a House ad.

313. Figure 42 below depicts the auction dynamics prior to UPR.

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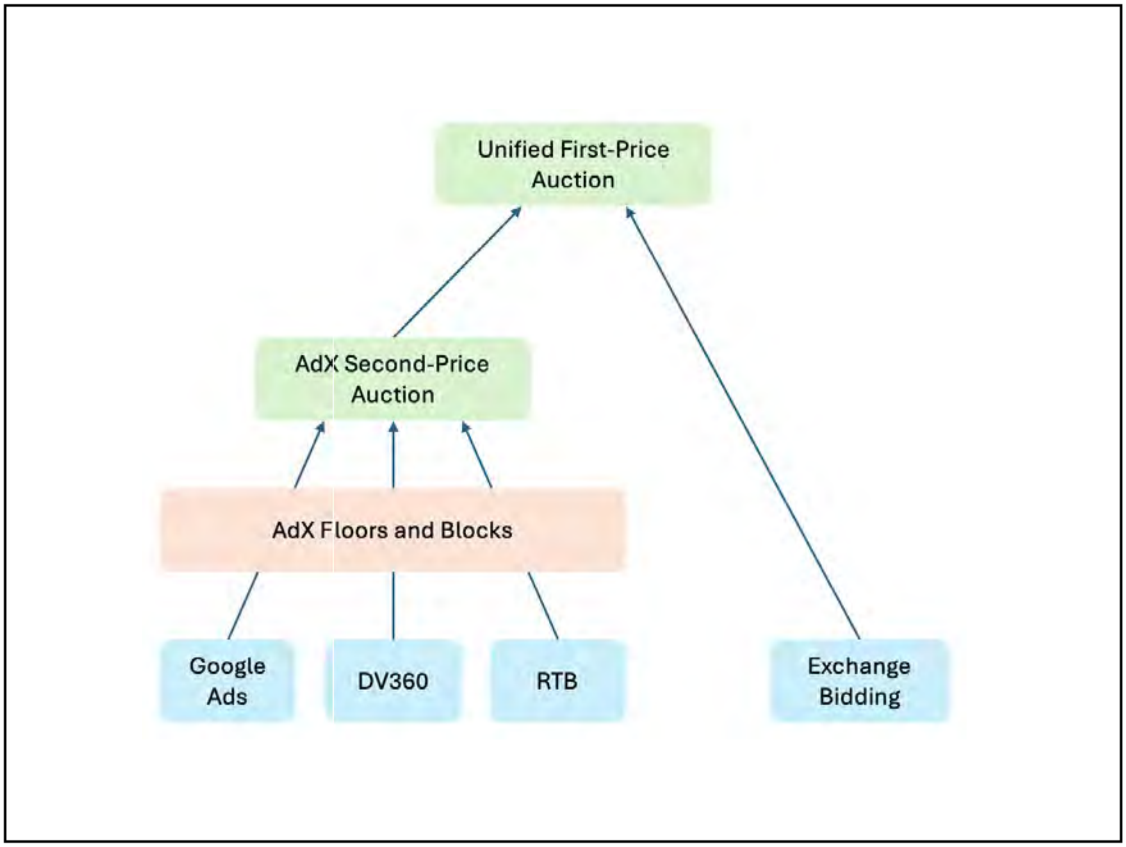
[879] Google internal document, "AdX Auction: Price Thresholds," (January 24, 2022) GOOG-AT-MDL-012693321 at '324 (HCI); Google internal document, "go/rpo-exemption-policy," (December 2017) GOOG-DOJ-28486313 at '314 (CI).
[880] Google internal document, "Jedi Auction, GA-style," GOOG-TEX-01280212 at '213 (CI); Google internal document, "1st Price Migration," GOOG-DOJ-28243636 at '640 (CI); Google internal document, "The Unified First Price Auction," (August 2019) GOOG-AT-MDL-000875073 at '083 (HCI).
[881] Google internal document, "AdX Dynamic Price," (August 2015) GOOG-NE-13204729 at '743 (HCI).
[882] Since AdX ran a second-price auction, the clearing price was equal to the maximum of the second highest bid and the price floor.

Figure 42: GAM auction dynamics prior to UPR[883]



B. Following the introduction of UPR, all indirect demand sources in GAM compete in a unified auction under a uniform price floor

314. With the launch of UPR, Google removed the intermediate second-price AdX auction, transitioning all indirect demand sources – AdX, Exchange Bidding participants and all remnant line items – to compete in a unified auction on a first-price basis, under a unified price floor. As such, the introduction of UPR was contemporaneous with the transition of AdX to a first-price auction. At the same time, as discussed in Section VII.B Google removed the Last Look advantage that AdX and Exchange Bidding participants had over remnant demand, which means that the highest vCPM among the non-guaranteed line items is no longer factored into the calculation of the auction floor.

315. As discussed above, prior to UPR publishers could set floors at the advertiser and buying tool levels GAM, and the third-party exchange level (through each third-party exchange's own platform). After UPR was launched, publishers could continue to set per-exchange floors through

883 Google internal document, "AdX First Price Auction," GOOG-TEX-00841386 at '392 (HCI).

each exchange's platform and per-advertiser floors.[884] However, publishers were no longer able to set per-buyer floors; in other words, publishers could not set a floor for Google Ads, DV360, and third-party DSPs and ad networks.[885]

316. Similarly, publishers were now more limited in the branding types they could select and the amount of information they could share with buyers. After the launch of UPR, publishers could still select the Branded and Semi-Transparent branding types, but the Anonymous branding type was removed.[886] This meant that publishers no longer had the option to send no information about the webpage visited by the user to buyers.

317. To facilitate UPR configurations, Google launched a central user interface enabling publishers to set price floors across indirect demand. Publishers are limited to 200 pricing rules per GAM account.[887] Each UPR specifies an auction floor for a given segment of inventory using either a fixed CPM, an average or target CPM or the "optimized floor" feature, which completely relinquishes control of floors to Google's models.[888] While the majority of pricing rules specify a single price floor, the targeting for floor prices can overlap across multiple rules and publishers can set multiple floor prices for each unified pricing rule.[889] Publishers can create custom floors for certain advertisers, brands, sizes and creative types; these custom floors apply to AdX and Exchange Bidding demand only.[890] When a bid request is made for a given segment of inventory, GAM retrieves the pricing rule(s) that target the specific request using selectors specified in the

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884 "Declaration of [redacted]," (August 4, 2023) GOOG-AT-MDL-008842393 at '405-'406 (HCI); Google, "Unified pricing rules," https://support.google.com/admanager/answer/9298008. Accessed May 23, 2024.

885 "Declaration of [redacted]," (August 4, 2023) GOOG-AT-MDL-008842393 at '406 (HCI); Google internal document, "The Unified First Price Auction," (August 2019) GOOG-AT-MDL-000875073 at '083 (HCI).

886 Google internal document, "The Unified First Price Auction," (August 2019) GOOG-AT-MDL-000875073 at '083 (HCI); [redacted] Deposition, (May 24, 2024) at 652:24-654:10.

887 "Unified pricing rules," Google Ad Manager Help, https://support.google.com/admanager/answer/9298008. Accessed May 23, 2024.

888 Target cost-per-thousand impressions is the bid set based on the average amount advertisers are willing to pay every thousand times their ad is shown. Google Ads, "Target cost-per-thousand impressions (tCPM)," https://support.google.com/google-ads/answer/9158634. Accessed May 24, 2024; "Optimized floors" is internally referred to as "optimized pricing rules" at Google and is not to be confused with RPO, described in Section XIII, which is marketed as "optimized pricing." "Optimized floors" is a feature that sets revenue-maximizing floors based using models that account for bidder behavior. *See* Google internal document, "2-Pager: RPO + OPR Commercialization," GOOG-AT-MDL-000989823 at '823-824 (HCI).

889 Google internal document, "PRD: Bid Insights – Auction Simulator," (January 24, 2020) GOOG-DOJ-AT-02200940 at '941 (HCI).

890 Google internal document, "1st Price Auction Unified Pricing Rules," GOOG-AT-MDL-000993900 at '914 (CI). Floor prices for a specific advertiser, brand, size, or other item are not included in the floor price sent to buyers. Google, "Unified pricing rules," https://support.google.com/admanager/answer/9298008. Accessed May 23, 2024.

rule, such as candidate matching and targeting.[891] If the request matches more than one rule, the rule with the highest fixed CPM or publisher-entered target CPM applies.[892] Conversely, if no rules match the targeting, the UPR floor defaults to $0.[893]

318. Once an impression becomes available on a publisher website:

1) If the publisher has a Header Bidding tag, the Header Bidding auction runs first. The floors here are not bound by UPR as the auction takes place outside of DFP.

2) Header Bidding bids are passed into DFP as remnant line items.

3) GAM determines which UPR rule(s) apply to the inventory and selects the maximum floor of all rules that apply.

4) GAM invokes Enhanced Dynamic Allocation. Temporary CPM (tCPM) is calculated for eligible guaranteed line items.

5) GAM invokes the same floor "optimization" features described in the pre-UPR process, except that second-price RPO is overridden by first-price RPO, as explained in Section XIII. Note that post-UPR, these features apply across all indirect demand. For example, the target CPM, which previously only applied to AdX and Exchange Bidding buyers, now extends to remnant line items with value CPMs, and can be enabled or disabled by the publisher on a per-rule basis.[894]

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891 Google internal document, "AdX Auction: Price Thresholds," (January 24, 2022) GOOG-AT-MDL-012693321 at '325 (HCI).

892 If only fixed CPM rules apply to a given piece of inventory, the one with the highest value will be the final floor. If only rules with tCPMs apply to the inventory, the one with the highest target value will be applied; however, the final floor may be lower than the target if Google's target CPM model determines that this is the optimal floor for the inventory. If a mix of fixed and target CPM rules apply to the inventory, the one with the highest fixed or target value will be selected; however, if a target CPM rule is selected, the value of the final floor determined by the tCPM model cannot be lower than any fixed CPM that applies. In conclusion, if only fixed CPM rules apply to an auction, the floor value of that auction will never be lower than any of the values specified in those rules. Google internal document, "Optimized Pricing Rules Design Doc," GOOG-AT-MDL-001403170 at '171 (HCI); Google internal document, "AdX Auction: Price Thresholds," (January 24, 2022) GOOG-AT-MDL-012693321 at '325 (HCI).

893 Google internal document, "1st Price Auction Unified Pricing Rules," GOOG-AT-MDL-000993900 at '919 (CI).

894 Google internal document, "1st Price Auction Unified Pricing Rules," GOOG-AT-MDL-000993900 at '922 (CI).

6) The Unified Auction floor is determined according to the below formula.[895]

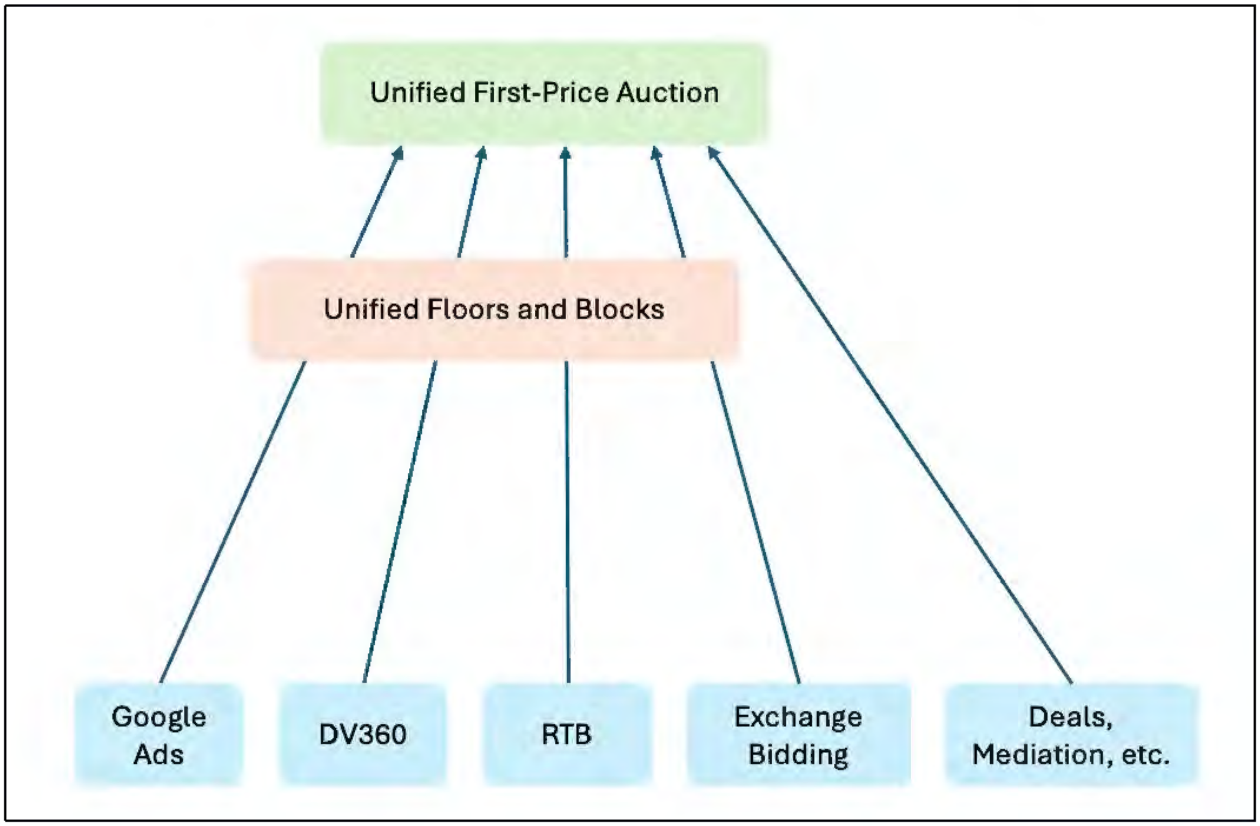
[redacted]

7) Buying All indirect demand sources, including AdX, Exchange Bidding, remnant line items (including Header Bidding line items) and guaranteed line items compete under the same floor in a unified auction. Google selects the candidate with the highest bid that beats the floor price as the winner.

8) If no winner is selected, a House line item gets served. Note that UPR does not apply to House line items, so they are not bound by the Unified Pricing Rules.[896]

319. Figure 43 shows the auction dynamics after the launch of UPR.

Figure 43: GAM auction dynamics after UPR launch[897]



[895] Google internal document, "Product Strategy for Auction Floors," (July 13, 2020) GOOG-AT-MDL-006197129 at '129 (CI); See Appendix C Section B.32 for findings from my analysis of Google's source code on the different CPM thresholds for floor sharing and auction candidate filtering.
[896] Google Ad Manager Help, "Unified pricing rules," https://support.google.com/admanager/answer/9298008. Accessed May 23, 2024.
[897] Google internal document, "AdX First Price Auction," GOOG-TEX-00841386 at '393 (HCI).

C. House Line Items allowed for circumvention of UPR

320. House line items are the lowest priority line items and are served when an ad cannot otherwise be filled. They usually contain advertisements for the publisher's own product (for example, an ad calling users to subscribe for the New York Times on the New York Times website).[898] Publishers have an option to set a CPM in order to establish an order of priority for House ads to serve.[899] For example, if a publisher only has one $2.00 floor rule for all of their inventory, and an impression becomes available that neither guaranteed nor remnant demand can fill, a House line item with a CPM of $1.00 can still be served as a fallback option. If there were two house line items with CPMs of $1.00 and $0, the ad with the $1.00 "bid" would be displayed.

321. Because House line items do not fall under Unified Pricing Rules, publishers discovered a way to utilize them to circumvent the program.[900] The strategy entailed setting high price floors through the Unified Pricing Rules, while sending their Header Bidding Price Priority line items to House line items instead.[901] As line items covered by UPR (*e.g.,* Price Priority, Bulk, Network line items and AdX) are served before House line items, publisher inventory was first offered at a high price for remnant demand, including AdX. If the inventory did not sell at that high price, it would be sold via House line items at lower prices through Header Bidding third-party exchanges, similarly to the way auctions were often structured prior to UPR.

322. In response to publishers circumventing UPR, Google updated its line item use policy to deem any use of House line items for ads that are not for the publisher's own product as "invalid activity."[902] [redacted] was one of the publishers Google noticed utilizing House line items to circumvent UPR.[903] A communication document set to be publicly announced in January 2020, states that "house line items may only be used for representing demand where you, the Ad Manager account, own the product or service being advertised," and that "you may only use line items for the specific purposes described below and any other use will be treated as invalid

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898 Google Ad Manager Help, "System maximums and limits," https://support.google.com/admanager/answer/1628457. Accessed May 24, 2024.
899 Google Ad Manager Help, "House line items," https://support.google.com/admanager/answer/79305?hl=en. Accessed May 23, 2024.
900 Google internal document, "AccuWeather notes," (November 13, 2019) GOOG-TEX-00857298 at '298 (HCI).
901 Google internal email, (September 26, 2019) GOOG-DOJ-AT-00175537 at '537 (HCI).
902 Google internal document, "DotDash Ad Manager Line Item policy change," (January 21, 2020) GOOG-DOJ-AT-02169562 at '563 (HCI).
903 Google internal email, (September 26, 2019) GOOG-DOJ-AT-00175537 at '537 (HCI).

activity."[904] Google gave [redacted] 90 days to adjust their line items berna the new policy went into effect.[905] [redacted] reaction was that this policy change "was a big deal and [[redacted] had] put in work/time to get in a stable place where they are now. Google [is] forcing a disruption in their business & requiring a lot of work from their end to readjust strategy."[906] As of 2024, the same policy applies to GAM House line items.[907]

* * *

323. While the systems laid out above are separated by section, it is my opinion that the implementation or use of any individual system did not foreclose the use of a separate system for any particular auction. I understand that, to the extent the system existed at that time, any individual auction could have any, all, or any combination of the above systems run.

904 Google internal document, "[redacted] Ad Manager Line Item policy change," (January 21, 2020) GOOG-DOJ-AT-02169562 at '563 (HCI).
905 Google internal document, "[redacted] Ad Manager Line Item policy change," (January 21, 2020) GOOG-DOJ-AT-02169562 at '565 (HCI).
906 Google internal document, "[redacted] Ad Manager Line Item policy change," (January 21, 2020) GOOG-DOJ-AT-02169562 at '564 (HCI).
907 Google Ad Manager Help, "System maximums and limits," https://support.google.com/admanager/answer/1628457. Accessed May 24, 2024.

XV. APPENDIX A: MATERIALS RELIED UPON

A. Declarations, Depositions and ROG responses

Declaration of [redacted] (August 4, 2023) and exhibits

Deposition of [redacted] (April 23, 2024) and exhibits

Deposition of [redacted] (April 1, 2024) and exhibits

Deposition of [redacted] (April 19, 2024) and exhibits

Deposition of [redacted] (April 26, 2024) and exhibits

Deposition of [redacted] (May 23, 2024) and exhibits

Deposition of [redacted] (April 17, 2024) and exhibits

Deposition of [redacted] (April 24, 2024) and exhibits

Deposition of [redacted] (April 19, 2024) and exhibits

Deposition of [redacted] (April 3, 2024) and exhibits

Deposition of [redacted] (April 12, 2024) and exhibits

Google's First Amended Responses and Objections to Plaintiff's Third Set of Interrogatories (May 24, 2024)

B. Documents from Production

GOOG-AT-MDL-000009165

GOOG-AT-MDL-000875073

GOOG-AT-MDL-000880955

GOOG-AT-MDL-000989823

GOOG-AT-MDL-000993446

GOOG-AT-MDL-000993483

GOOG-AT-MDL-000993900

GOOG-AT-MDL-001004706

GOOG-AT-MDL-001110980

GOOG-AT-MDL-001132667

GOOG-AT-MDL-001284725

GOOG-AT-MDL-001391101

GOOG-AT-MDL-001403170

GOOG-AT-MDL-001409774

GOOG-AT-MDL-001412616

GOOG-AT-MDL-001418741

GOOG-AT-MDL-001418931

GOOG-AT-MDL-001421306

GOOG-AT-MDL-001793318

GOOG-AT-MDL-001963256

GOOG-AT-MDL-001963813

GOOG-AT-MDL-001971579

GOOG-AT-MDL-002011973

GOOG-AT-MDL-002295716

GOOG-AT-MDL-002307536

GOOG-AT-MDL-003109989

GOOG-AT-MDL-003565982

GOOG-AT-MDL-003991554

GOOG-AT-MDL-004016998
GOOG-AT-MDL-004122442
GOOG-AT-MDL-004221745
GOOG-AT-MDL-004284449
GOOG-AT-MDL-004288612
GOOG-AT-MDL-004291695
GOOG-AT-MDL-004300268
GOOG-AT-MDL-004434946
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GOOG-AT-MDL-013211457
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GOOG-AT-MDL-013274837
GOOG-AT-MDL-013288759
GOOG-AT-MDL-015236044
GOOG-AT-MDL-016353371
GOOG-AT-MDL-016353630
GOOG-AT-MDL-016354429
GOOG-AT-MDL-016354537
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GOOG-AT-MDL-018630622
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GOOG-AT-MDL-B-001628818
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GOOG-AT-MDL-B-005090414
GOOG-AT-MDL-B-005180695
GOOG-AT-MDL-B-005180709
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GOOG-DOJ-13615596
GOOG-DOJ-14031764
GOOG-DOJ-14138199
GOOG-DOJ-14141075
GOOG-DOJ-14240302
GOOG-DOJ-14298902
GOOG-DOJ-14609574
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GOOG-DOJ-15432462
GOOG-DOJ-15435288
GOOG-DOJ-15637938
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GOOG-DOJ-28243636
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GOOG-DOJ-28486025
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GOOG-DOJ-AT-00599602
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GOOG-DOJ-AT-02134358
GOOG-DOJ-AT-02148683
GOOG-DOJ-AT-02169562
GOOG-DOJ-AT-02180605
GOOG-DOJ-AT-02199478
GOOG-DOJ-AT-02200940
GOOG-DOJ-AT-02224828
GOOG-DOJ-AT-02231173
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GOOG-NE-07834872
GOOG-NE-09149436
GOOG-NE-10646295

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GOOG-NE-10942712
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GOOG-NE-12065295
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GOOG-NE-13204977
GOOG-NE-13207241
GOOG-NE-13208126
GOOG-NE-13216501

GOOG-NE-13217060
GOOG-NE-13226622

GOOG-NE-13550381
GOOG-NE-13558460
GOOG-NE-13614574
GOOG-NE-13620081
GOOG-NE-13624783
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GOOG-TEX-00055792
GOOG-TEX-00074558
GOOG-TEX-00217546
GOOG-TEX-00260934
GOOG-TEX-0082070
GOOG-TEX-00830552
GOOG-TEX-00841386
GOOG-TEX-00856580
GOOG-TEX-00857298
GOOG-TEX-00858434
GOOG-TEX-00949710
GOOG-TEX-00971457
GOOG-TEX-00971726
GOOG-TEX-00971841
GOOG-TEX-00983966
GOOG-TEX-01280212
[redacted]

C. Public Sources

Abhilasha, headerbidding, "Google Ad Manager or Google Ad Manager 360 – What Should a Publisher Choose?" https://headerbidding.co/google-ad-manager-vs-ad-manager-360/. Accessed May 23, 2024.

Adjust, "What is an impression?" https://www.adjust.com/glossary/impression/. Accessed April 23, 2024.

Adjust, "What is native advertising," https://www.adjust.com/glossary/native-advertising/. Accessed May 23, 2024.

AdMeld, "Superior Technology, Superior Results," https://web.archive.org/web/20101225163051/http://www.admeld.com/technology.html. Accessed May 31, 2024.

Amazon Ads, "Ad Servers and how they work," https://advertising.amazon.com/library/guides/ad-server. Accessed June 5, 2024.

Amazon Ads, "What is an ad exchange? Learn how they work," https://advertising.amazon.com/library/guides/ad-exchange. Accessed June 5, 2024.

Amazon Customer Service, "About Cookies" (January 1, 2020). https://www.amazon.com/gp/help/customer/display.html?nodeId=GV. Accessed June 5, 2024.

Amazon, "Transparent Ad Marketplace," https://aps.amazon.com/aps/transparent-ad-marketplace/. Accessed May 23, 2024.

Aqeel, W., Bhattacherjee, D., et al., "Untangling Header Bidding Lore: Some Myths, Some Truths, and Some Hope," In: Sperotto, A., Dainotti, A., Stiller, B. (eds) Passive and Active Measurement. PAM 2020. Lecture Notes in Computer Science, vol 12048. Springer, Cham. https://doi.org/10.1007/978-3-030-44081-7_17.

Australian Competition & Consumer Commission, "Digital advertising services inquiry," (August 2021), https://www.accc.gov.au/system/files/Digital%20advertising%20services%20inquiry%20-%20final%20report.pdf. Accessed May 24, 2024

Authorized Buyers Help, "Authorized Buyers Overview," https://support.google.com/authorizedbuyers/answer/6138000. Accessed May 30, 2024.

Authorized Buyers Help, "Introduction to real-time-bidding (RTB)," https://support.google.com/authorizedbuyers/answer/6136272. Accessed May 23, 2024.

Barth A., Internet Engineering Task Force (IETF) Request for Comments (RFC) 6265, "HTTP State Management Mechanism" (April 2011). https://datatracker.ietf.org/doc/html/rfc6265. Accessed June 5, 2024.

Bellack J., Google Ad Manager, "Introducing Google Ad Manager," https://blog.google/products/admanager/introducing-google-ad-manager/. Accessed May 23, 2024.

Bellack J., Google Ad Manager, "Introducing Google Ad Manager," https://support.google.com/admanager/answer/9298008. Accessed May 23, 2024.

Bigabid, "Whaterfall vs. Header Bidding, Everything you Need to Know," https://www.bigabid.com/waterfall-vs-header-bidding/. Accessed May 23, 2024.

Bigler J., "Rolling out first price auctions to Google Ad Manager partners," https://blog.google/products/admanager/rolling-out-first-price-auctions-google-ad-manager-partners/. Accessed May 23, 2024.

Bigler, J., "An update on first price auctions for Google Ad Manager," https://blog.google/products/admanager/update-first-price-auctions-google-ad-manager/. Accessed May 30, 2024.

Campaign Manager 360 Help, "Overview of Campaign Manager 360," https://support.google.com/campaignmanager/answer/2709362. Accessed June 6, 2024.

Cheikha E., Outbrain, (2023), "The Remarketing Guide for Dummies," https://www.outbrain.com/blog/remarketing-guide/. Accessed May 23, 2024.

Clearcode, "Ad slot," https://clearcode.cc/glossary/ad-slot-definition/. Accessed May 23, 2024.

Cox, S., "Announcing Exchange Bidding open beta," https://blog.google/products/admanager/announcing-exchange-bidding-open-beta/. Accessed May 23, 2024.

Criteo, "What is the difference between CPC and CPM?" https://www.criteo.com/blog/whats-difference-cpc-cpm/. Accessed May 23, 2024.

Description of capabilities of DSPs, "What is a demand-side platform (DSP)?" https://www.adjust.com/glossary/demand-side-platform/. Accessed May 23, 2024.

Digiday, "'An ad tech urban legend': An oral history of how header bidding became digital advertising's hottest buzzword," https://digiday.com/media/header-bidding-oral-history/. Accessed May 23, 2024.

Display & Video 360 Help, "Introducing Google Marketing Platform," https://support.google.com/displayvideo/answer/9015629. Accessed June 4, 2024.

Display & Video 360 Help, "Managing exchanges," https://support.google.com/displayvideo/answer/9230278?hl=en. Accessed June 6, 2024.

Display & Video 360 Help, "Supported display exchanges," https://support.google.com/displayvideo/table/3267029?hl=en. Accessed June 6, 2024.

Display & Video 360 Help, "What's new: July 2023," https://support.google.com/displayvideo/answer/13840246. Accessed May 23, 2024.

DV360: Display & Video 360 Help, "Create a campaign," https://support.google.com/displayvideo/answer/7205081. Accessed May 21, 2024.

Examples of set-up pages from different buyside tools: Trade Desk: Partner portal, "Campaign," https://partner.thetradedesk.com/v3/portal/api/doc/Campaign. Accessed May 21, 2024.

Flanagan J., adtaxi, "The Origins and Progression of Real-Time Bidding," https://www.adtaxi.com/blog/origins-progression-real-time-bidding/. Accessed May 23, 2024.

GAM (DFP and AdX), https://admanager.google.com/home. Accessed May 23, 2024.

Ganz E., ADCORE Blog, "What is DV360 and How to Start Advertising," https://www.adcore.com/blog/what-is-dv360-and-how-to-start-advertising. Accessed May 23, 2024.

Google Ad Manager Help, "Get started with ads in Google Ad Manager," https://support.google.com/admanager/answer/6027116. Accessed May 23, 2024.

Google Ad Manager Help, "About line items," https://support.google.com/admanager/answer/9405477. Accessed May 23, 2024.

Google Ad Manager Help, "About publisher provided identifiers," https://support.google.com/admanager/answer/2880055. Accessed May 23, 2024.

Google Ad Manager Help, "Ad Manager report metrics," https://support.google.com/admanager/table/7568664. Accessed May 23, 2024.

Google Ad Manager Help, "Add new line items," https://support.google.com/admanager/answer/82236. Accessed June 4, 2024.

Google Ad Manager Help, "Advertising with Google Ad Manager," https://support.google.com/admanager/answer/6022000. Accessed May 23, 2024.

Google Ad Manager Help, "Compare Ad Manager, AdSense, and AdMob," https://support.google.com/admanager/answer/9234653. Accessed May 23, 2024.

Google Ad Manager Help, "Create a new report," https://support.google.com/admanager/answer/2643320. Accessed May 23, 2024.

Google Ad Manager Help, "Create and manage yield groups," https://support.google.com/admanager/answer/7390828. Accessed May 23, 2024.Google Ad Manager Help, "Generate ad tags," https://support.google.com/admanager/answer/177207. Accessed May 23, 2024.

Google Ad Manager Help, "House line items," https://support.google.com/admanager/answer/79305. Accessed May 23, 2024.

Google Ad Manager Help, "Introduction to Open Bidding," https://support.google.com/admanager/answer/7128453. Accessed May 23, 2024.

Google Ad Manager Help, "Line item types and priorities," https://support.google.com/admanager/answer/177279. Accessed May 23, 2024.

Google Ad Manager Help, "Network line items," https://support.google.com/admanager/answer/171909. Accessed May 23, 2024.

Google Ad Manager Help, "Optimize pricing to reflect inventory's value," https://support.google.com/admanager/answer/12243638?hl=en. Accessed June 7, 2024.

Google Ad Manager Help, "Overview of Google Publisher Tag," https://support.google.com/admanager/answer/181073. Accessed May 30, 2024.

Google Ad Manager Help, "Payment rules," https://support.google.com/admanager/answer/2671028. Accessed May 23, 2024.

Google Ad Manager Help, "Programmatic Guaranteed vs. Preferred Deals," https://support.google.com/admanager/answer/7637485. Accessed May 23, 2024.

Google Ad Manager Help, "Report types in Ad Manager," https://support.google.com/admanager/answer/10117711. Accessed May 23, 2024.

Google Ad Manager Help, "System maximums and limits," https://support.google.com/admanager/answer/1628457. Accessed May 24, 2024.

Google Ad Manager Help, "Target CPM," https://support.google.com/admanager/answer/10357452?hl=en. Accessed June 7, 2024.

Google Ad Manager Help, "Value CPM," https://support.google.com/admanager/answer/177222. Accessed May 23, 2024.

Google Ad Manager, "Unified First-Price Auction – Best practices," https://services.google.com/fh/files/misc/unified_first-price_auction_best_practices.pdf. Accessed May 23, 2024.

Google Ad Manager, "What are creatives?" https://support.google.com/admanager/answer/3185155?hl=en. Accessed June 7, 2024.

Google Ads Help, "About bidding features in Display campaigns," https://support.google.com/google-ads/answer/2947304. Accessed May 23, 2024.

Google Ads Help, "About the Display Network ad auction," https://support.google.com/google-ads/answer/2996564. Accessed May 21, 2024.

Google Ads Help, "Create a Search campaign," https://support.google.com/google-ads/answer/9510373. Accessed May 23, 2024.

Google Ads Help, "Fix low traffic or conversion rate for Target CPA," https://support.google.com/google-ads/answer/638515. Accessed May 23, 2024.

Google Ads Help, "Maximize clicks: Definition," https://support.google.com/google-ads/answer/6336101. Accessed May 23, 2024.

Google Ads Help, "Maximum CPC bid: Definition," https://support.google.com/google-ads/answer/6326. Accessed May 23, 2024.

Google Ads, "How to set up your first Google Ads campaign," https://ads.google.com/intl/en_us/home/how-it-works/. Accessed May 23, 2024.

Google Ads, "Target cost-per-thousand impressions (tCPM)," https://support.google.com/google-ads/answer/9158634. Accessed May 24, 2024.

Google Ads, "Unified pricing rules," https://support.google.com/admanager/answer/9298008. Accessed May 23, 2024.

Google Ads, https://ads.google.com. Accessed May 23, 2024.

Google Ads, https://ads.google.com/intl/en_us/home/campaigns/search-ads/. Accessed May 23, 2024.

Google Ads Help, "About Display ads and the Google Display Network," https://support.google.com/google-ads/answer/2404190. Accessed June 6, 2024.

Google Ads Help, "Create a campaign," https://support.google.com/google-ads/answer/6324971. Accessed May 21, 2024.

Google for Developers, "Cookie Matching | Real-time Bidding," https://developers.google.com/authorized-buyers/rtb/cookie-guide. Accessed June 7, 2024.

Google Marketing Platform, "Improve Campaign performance with new automated bidding solutions," https://blog.google/products/marketingplatform/360/improve-campaign-performance-new-automated-bidding-solutions/. Accessed May 23, 2024.

Google Marketing Platform, https://marketingplatform.google.com/about/display-video-360/. Accessed May 23, 2024.

Google Publisher Tag, "Get Started with Google Publisher Tag," https://developers.google.com/publisher-tag/guides/get-started. Accessed May 23, 2024.

Google, "3 questions businesses should ask when they get started with Google Ads," https://blog.google/outreach-initiatives/small-business/small-business-google-ads-tips/. Accessed May 23, 2024.

Google, "About campaign goal types," https://support.google.com/admob/answer/9152820. Accessed May 23, 2024.

Google, "Ad competition with dynamic allocation," https://support.google.com/admanager/answer/3721872. Accessed May 23, 2024.

Google, "Clickthrough rate (CTR): Definition," https://support.google.com/google-ads/answer/2615875. Accessed May 23, 2024.

Google, "Control ad loading and refresh," https://developers.google.com/publisher-tag/guides/control-ad-loading. Accessed May 23, 2024.

Google, "Generate Ad Exchange Ad Tags," https://support.google.com/admanager/answer/7501422. Accessed May 30, 2024.

Google, "Get started with key-values," https://support.google.com/admanager/answer/188092. Accessed May 30, 2024.

Google, "Get started with Open Bidding," https://support.google.com/admanager/answer/7128657. Accessed May 30, 2024.

Google, "Glossary," https://support.google.com/admanager/table/7636513. Accessed May 23, 2024.

Google, "Google Expands Advertising Monetization Program for Websites," https://googlepress.blogspot.com/2003/06/google-expands-advertising-monetization.html. Accessed May 23, 2024.

Google, "Google Launches Self-Service Advertising Program," https://googlepress.blogspot.com/2000/10/google-launches-self-service.html. Accessed May 23, 2024.

Google, "Google to Acquire DoubleClick," https://googlepress.blogspot.com/2007/04/google-to-acquire-doubleclick_13.html. Accessed May 23, 2024.

Google, "Helping publishers get the most from display advertising with Admeld," https://googleblog.blogspot.com/2011/06/helping-publishers-get-most-from.html. Accessed June 3, 2024.

Google, "How Open Bidding works," https://support.google.com/admanager/answer/7128958. Accessed May 23, 2024.

Google, "How we decide which ad is served," https://support.google.com/admanager/answer/11204312. Accessed May 23, 2024.

Google, "Introducing the next generation of the DFP ad tag," https://doubleclick-publishers.googleblog.com/2011/10/introducing-next-generation-of-dfp-ad.html. Accessed June 4, 2024.

Google, "Manual CPC bidding," https://support.google.com/google-ads/answer/2390250. Accessed May 24, 2024.

Google, "OpenRTB Integration," https://developers.google.com/authorized-buyers/rtb/openrtb-guide. Accessed May 23, 2024.

Google, "Optimized competition," https://support.google.com/admanager/answer/7422526. Accessed May 23, 2024.

Google, "Targeting types," https://support.google.com/admanager/answer/2884033. Accessed May 24, 2024.

Google, "Third-party ad serving (3PAS)," https://support.google.com/authorizedbuyers/answer/2961247. Accessed May 23, 2024.

Google, "Ad selection white paper," https://support.google.com/admanager/answer/1143651?sjid=16185194441614631351-NA. Accessed June 6, 2024.

Greenfield I., mntn, "Ad Exchange: What Is It and How Does it Work?" https://mountain.com/blog/what-is-an-ad-exchange/. Accessed May 23, 2024.

Greenfield I., mntn, "Demand Side Platform (DSP): What Is It and How Does It Work?" https://mountain.com/blog/demand-side-platform/. Accessed May 23, 2024.

headerbidding, "Price Floor Optimization – a Guide for Publishers," https://headerbidding.co/price-floor-optimization/. Accessed May 23, 2024.

IAB Australia, "Auction Mechanics Handbook v2.0" (February 2019), https://iabaustralia.com.au/wp-content/uploads/2019/02/Auction_Mechanics_V2.0_Feb2019.pdf. Accessed June 6, 2024.

IAB Tech Lab, "OpenRTB," https://iabtechlab.com/standards/openrtb/. Accessed May 23, 2024.

Incubeta DQ&A, "DQ&A Webinar: Google Ad Exchange Ad Manager 360 [Advanced]" (May 3, 2019) https://www.youtube.com/watch?v=UpXq66ME1gQ.

Jain A., Tatvic, "What is the Difference between DV360 and Google Ads?" https://www.tatvic.com/blog/what-is-the-difference-between-dv360-and-google-ads/. Accessed May 23, 2024.

Kaspersky, "What are Cookies?" https://usa.kaspersky.com/resource-center/definitions/cookies. Accessed May 23, 2024.

Kaspersky, "What is an IP Address – Definition and Explanation," https://usa.kaspersky.com/resource-center/definitions/what-is-an-ip-address. Accessed May 23, 2024.

Khor N., Publift, "What is a Supply-Side Platform?" https://www.publift.com/adteach/what-is-a-supply-side-platform. Accessed May 23, 2024.

Khor N., Publift, "What is Programmatic Advertising? How Does it Work?" https://www.publift.com/adteach/what-is-programmatic-advertising. Accessed May 23, 2024.

Maciej, Z. and Mike, S., "What is Waterfalling and How Does it Work?" https://clearcode.cc/blog/what-is-waterfalling/. Accessed May 23, 2024.

Medium, "Google Ads vs. DV360: Which One is Better?" https://medium.com/@contact_10971/google-ads-vs-dv360-which-one-is-better-8fbd3a883787. Accessed May 23, 2024.

Microsoft Edge Team, Microsoft Edge Blog, "New Privacy-Preserving Ads API coming to Microsoft Edge" (March 5, 2024), https://blogs.windows.com/msedgedev/2024/03/05/new-privacy-preserving-ads-api/. Accessed June 6, 2024.

Mills, C., Mozilla, "Saying goodbye to third-party cookies in 2024," https://developer.mozilla.org/en-US/blog/goodbye-third-party-cookies/. Accessed May 24, 2024.

Mozilla Support Firefox Help, "Cookies - Information that websites store on your computer" (July 29, 2023), https://support.mozilla.org/en-US/kb/cookies-information-websites-store-on-your-computer. Accessed June 5, 2024.

Mozilla, "CSS basics," https://developer.mozilla.org/en-US/docs/Learn/Getting_started_with_the_web/CSS_basics. Accessed May 23, 2024.

Mozilla, "HTML basics," https://developer.mozilla.org/en-US/docs/Learn/Getting_started_with_the_web/HTML_basics. Accessed May 23, 2024.

Mozilla, "HTML elements reference," https://developer.mozilla.org/en-US/docs/Web/HTML/Element. Accessed May 23, 2024.

Mozilla, "JavaScript basics," https://developer.mozilla.org/en-US/docs/Learn/Getting_started_with_the_web/JavaScript_basics. Accessed May 23, 2024.

Munro B., Publift, "Ultimate Guide to Ad Tags," https://www.publift.com/blog/ultimate-guide-to-ad-tags. Accessed May 23, 2024.

Munro B., Publift, "What is an Ad Exchange and How Does it Work?" https://www.publift.com/blog/what-is-an-ad-exchange. Accessed May 23, 2024.

Munro B., Publift, "What is Programmatic Direct," https://www.publift.com/blog/what-is-programmatic-direct. Accessed April 11, 2024.

Nguyen S., all about cookies, "What are Internet Cookies and How Are They Used?" https://allaboutcookies.org/what-is-a-cookie. Accessed May 23, 2024.

Novatska K., Cepom, "What is an Ad Tag and How to Generate It," https://epom.com/blog/ad-server/what-is-an-ad-tag. Accessed May 23, 2024.

playwire, "Ad Server vs. Ad Network," https://www.playwire.com/blog/ad-server-vs-ad-network. Accessed May 23, 2024.

Postman, "What are HTTP headers," https://blog.postman.com/what-are-http-headers/. Accessed May 23, 2024.

Prebid, "Ad Unit Reference," https://docs.prebid.org/dev-docs/adunit-reference.html. Accessed May 23, 2024.

Prebid, "Basic Prebid.js Example," https://docs.prebid.org/dev-docs/examples/basic-example.html. Accessed May 23, 2024.

Prebid, "Getting Started for Developers," https://docs.prebid.org/dev-docs/getting-started.html. Accessed May 24, 2024.

Prebid, "Hosting a Prebid Server Cluster," https://docs.prebid.org/prebid-server/hosting/pbs-hosting.html. Accessed May 24, 2024.

Prebid, "Introduction to Prebid," https://docs.prebid.org/overview/intro.html. Accessed May 23, 2024.

Prebid, "Key Values," https://docs.prebid.org/adops/key-values.html. Accessed May 23, 2024.

Prebid, "pbjs.addAdUnits(Array|Object)," https://docs.prebid.org/dev-docs/publisher-api-reference/addAdUnits.html. Accessed May 23, 2024.

Prebid, "pbjs.getBidResponses()," https://docs.prebid.org/dev-docs/publisher-api-reference/getBidResponses.html. Accessed May 23, 2024.

Prebid, "pbjs.requestBids(requestObj)," https://docs.prebid.org/dev-docs/publisher-api-reference/requestBids.html. Accessed May 23, 2024.

Prebid, "pbjs.setTargetingForGPTAsync([codeArr], customSlotMatching)," https://docs.prebid.org/dev-docs/publisher-api-reference/setTargetingForGPTAsync.html. Accessed May 23, 2024.

Prebid, "Prebid Server Overview," https://docs.prebid.org/prebid-server/overview/prebid-server-overview.html. Accessed May 24, 2024.

Prebid, "Price Floors Module," https://docs.prebid.org/dev-docs/modules/floors.html. Accessed June 7, 2024.

Prebid, "Price Granularity," https://docs.prebid.org/adops/price-granularity.html. Accessed June 4, 2024.

Prebid, "Server-Side Header Bidding with Prebid.js," https://docs.prebid.org/dev-docs/pbsBidAdapter-video-overview.html. Accessed May 24, 2024.

Prebid, "Troubleshooting Prebid.js," https://docs.prebid.org/troubleshooting/troubleshooting-guide.html. Accessed May 23, 2024.

Privacy Sandbox, "Prepare for third-party cookie restrictions," https://developers.google.com/privacy-sandbox/3pcd. Accessed May 21, 2024.

Programmads, "Why use DV360 instead of Google Ads?" https://programmads.com/project/why-use-display-video-360-instead-of-google-ads/. Accessed May 23, 2024.

Schonfeld E., techcrunch, "Google Confirms Invite Media Acquisition, Brings Bidding to Display Ads," https://techcrunch.com/2010/06/03/google-confirms-invite-media/. Accessed May 23, 2024.

Search Ads 360 Help, "Set up remarketing lists for search ads," https://support.google.com/searchads/answer/7196986?hl=en. Accessed June 7, 2024.

Seth A., adpushup, "Programmatic Deals vs. Direct Deals – Simplified Advertising Comparison," https://www.adpushup.com/blog/programmatic-vs-direct-deal/. Accessed May 23, 2024.

Seth A., adpushup, "What are Ad Tags and Why Do They Matter," https://www.adpushup.com/blog/ad-tags/. Accessed May 23, 2024.

Sweeney M., clearcode, "What is a Demand-Side Platform (DSP) and How Does It Work?" https://clearcode.cc/blog/demand-side-platform/. Accessed May 23, 2024.

Sweeney M., Zawadzinski M., clearcode, "What is an Ad Server and How does it work?" https://clearcode.cc/blog/what-is-an-ad-server/. Accessed May 23, 2024.

Taylor, R., Criteo, "Header Bidding Demystified: Client-Side vs. Server-Side," https://www.criteo.com/blog/header-bidding-demystified-client-side-vs-server-side/. Accessed May 23, 2024.

The Trade Desk, "Glossary," https://www.thetradedesk.com/us/glossary. Accessed June 5, 2024.

Titone T., ad tech explained, "Real-Time Bidding Explained – How do ad auctions work?" https://adtechexplained.com/real-time-bidding-explained/. Accessed May 30, 2024.

Urwin M., builtin, "Adtech Definition," https://builtin.com/adtech-martech. Accessed May 23, 2024.

Vaibhav P., aniview, "What is an ad server? How does ad serving work?" https://aniview.com/what-is-an-ad-server-how-does-ad-serving-work/. Accessed May 23, 2024.

Zaiceva A., "First-Price vs. Second-Price Auction | Difference Explained," https://setupad.com/blog/first-price-vs-second-price-auction/. Accessed January 31, 2024.

Zaiceva A., "Google Publisher Tag (GPT): A Complete Beginner's Guide," https://setupad.com/blog/google-gpt/. Accessed May 23, 2024.

Zaiceva A., setupad, "Google AdX vs. Google AdSense | Difference Explained," https://setupad.com/blog/adsense-vs-ad-exchange/. Accessed May 30, 2024.

Zaiceva A., setupad, "What is an Ad Server & 10 Best Ad Servers for Publishers," https://setupad.com/blog/ad-server/. Accessed May 23, 2024.

Zaiceva A., Setupad, "What is Header Bidding? | A Complete Guide for Publishers," https://setupad.com/blog/what-is-header-bidding/. Accessed May 23, 2024.

Zaiceva, A., Setupad, "Header Bidding vs Waterfall | Differences Explained," https://setupad.com/blog/header-bidding-vs-waterfall/. Accessed May 23, 2024.

Zawadzinski M., Sweeney M., clearcode, "What Is an Ad Network and How Does It Work?" https://clearcode.cc/blog/what-is-an-ad-network-and-how-does-it-work/. Accessed May 23, 2024.

XVI. APPENDIX B: MATERIALS CONSIDERED

A. Declarations, Depositions and ROG responses

a. Discovery Responses

All available discovery responses produced within the matter of The State of Texas, et al. v. Google, Case Number: 4:20-cv-00957-SDJ, including:

The Parties' amended initial disclosures;

The Parties' discovery responses and objections to Interrogatories, Requests for Admission, and Requests for Production; and

Google's written responses to Plaintiffs' Rule 30(b)(6) Notice.

b. Deposition Transcripts & Exhibits

All available deposition transcripts and exhibits within the matter of The State of Texas, et al. v. Google, Case Number: 4:20-cv-00957-SDJ, including:

Deposition and Exhibits of Alaska ([redacted]), May 3, 2024

Deposition and Exhibits of [redacted], May 15, 2024

Deposition and Exhibits of [redacted], April 23, 2024

Deposition and Exhibits of [redacted], May 2, 2024

Deposition and Exhibits of [redacted], May 2, 2024

Deposition and Exhibits of Arkansas ([redacted]), May 1, 2024

Deposition and Exhibits of [redacted], May 1, 2024

Deposition and Exhibits of [redacted], May 1, 2024

Deposition and Exhibits of [redacted], May 1, 2024

Deposition and Exhibits of [redacted] (April 1, 2024)

Deposition and Exhibits of [redacted], April 29, 2024

Deposition and Exhibits of [redacted] May 23, 2024

Deposition and Exhibits of [redacted], May 23, 2024

Deposition and Exhibits of [redacted], April 19, 2024

Deposition and Exhibits of [redacted], April 30, 2024

Deposition and Exhibits of [redacted], May 1, 2024

Deposition and Exhibits of [redacted] April 25, 2024

Deposition and Exhibits of [redacted], May 3, 2024

Deposition and Exhibits of [redacted], May 1, 2024

Deposition and Exhibits of Florida ([redacted]), April 22, 2024

Deposition and Exhibits of [redacted], May 3, 2024

Deposition and Exhibits of [redacted], May 3, 2024

Deposition and Exhibits of [redacted] May 17, 2024

Deposition and Exhibits of [redacted], May 3, 2024

Deposition and Exhibits of [redacted], May 2, 2024

Deposition and Exhibits of Idaho ([redacted]), May 3, 2024

Deposition and Exhibits of Idaho ([redacted]), May 3, 2024

Deposition and Exhibits of [redacted], April 23, 2024

Deposition and Exhibits of Indiana ([redacted]), April 26, 2024

Deposition and Exhibits of Indiana ([redacted]), April 26, 2024

Deposition and Exhibits of [redacted], May 1, 2024

Deposition and Exhibits of [redacted], April 26, 2024

Deposition and Exhibits of [redacted], April 25, 2024

Deposition and Exhibits of [redacted], April 16, 2024

Deposition and Exhibits of [redacted], May 10, 2024

Deposition and Exhibits of [redacted], April 23, 2024

Deposition and Exhibits of [redacted] May 24, 2024

Deposition and Exhibits of Kentucky ([redacted]), April 25, 2024

Deposition and Exhibits of [redacted], May 23, 2024

Deposition and Exhibits of [redacted], April 12, 2024

Deposition and Exhibits of [redacted], April 22, 2024

Deposition and Exhibits of Louisiana ([redacted]), May 3, 2024

Deposition and Exhibits of [redacted], April 3, 2024

Deposition and Exhibits of [redacted], April 30, 2024

Deposition and Exhibits of [redacted], April 17, 2024

Deposition and Exhibits of [redacted], May 1, 2024

Deposition and Exhibits of [redacted], May 2, 2024

Deposition and Exhibits of [redacted] April 30, 2024

Deposition and Exhibits of [redacted] May 2, 2024

Deposition and Exhibits of [redacted], May 21, 2024

Deposition and Exhibits of [redacted], May 22, 2024

Deposition and Exhibits of [redacted], April 22, 2024

Deposition and Exhibits of Mississippi ([redacted]), April 25, 2024

Deposition and Exhibits of Mississippi ([redacted]), April 25, 2024

Deposition and Exhibits of Missouri ([redacted]), May 10, 2024

Deposition and Exhibits of [redacted], May 2, 2024

Deposition and Exhibits of [redacted] May 1, 2024

Deposition and Exhibits of [redacted], May 2, 2024

Deposition and Exhibits of [redacted], May 1, 2024

Deposition and Exhibits of Montana ([redacted]), May 1, 2024

Deposition and Exhibits of [redacted], April 16, 2024

Deposition and Exhibits of [redacted], May 24, 2024

Deposition and Exhibits of Nevada ([redacted]), April 29, 2024

Deposition and Exhibits of [redacted] May 1, 2024

Deposition and Exhibits of [redacted], April 12, 2024

Deposition and Exhibits of [redacted] May 3, 2024

Deposition and Exhibits of [redacted] Vol 1, April 26, 2024

Deposition and Exhibits of [redacted] Vol 2, May 21, 2024

Deposition and Exhibits of [redacted] Vol 1, April 19, 2024

Deposition and Exhibits of [redacted] Vol 2, May 2, 2024

Deposition and Exhibits of [redacted] Vol 3, May 3, 2024

Deposition and Exhibits of [redacted] Vol 4, May 24, 2024

Deposition and Exhibits of North Dakota ([redacted]), May 2, 2024

Deposition and Exhibits of [redacted], April 30, 2024

Deposition and Exhibits of Puerto Rico ([redacted]), May 1, 2024

Deposition and Exhibits of [redacted], April 5, 2024

Deposition and Exhibits of [redacted], May 2, 2024

Deposition and Exhibits of South Carolina ([redacted]), April 23, 2024

Deposition and Exhibits of South Dakota ([redacted]), April 29, 2024

Deposition and Exhibits of [redacted], May 3, 2024

Deposition and Exhibits of [redacted], April 26, 2024

Deposition and Exhibits of [redacted], April 25, 2024

Deposition and Exhibits of Texas ([redacted]), April 17, 2024

Deposition and Exhibits of Texas ([redacted]), May 24, 2024

Deposition and Exhibits of [redacted], May 1, 2024

Deposition and Exhibits of [redacted], May 3, 2024

Deposition and Exhibits of [redacted] May 3, 2024

Deposition and Exhibits of [redacted] May 3, 2024

Deposition and Exhibits of [redacted] April 29, 2024

Deposition and Exhibits of [redacted] April 29, 2024

Deposition and Exhibits of [redacted], May 23, 2024

Deposition and Exhibits of [redacted], April 29, 2024

Deposition and Exhibits of [redacted], April 3, 2024

Deposition and Exhibits of Utah ([redacted]), April 30, 2024

Deposition and Exhibits of Utah ([redacted]), April 30, 2024

Deposition and Exhibits of [redacted] April 19, 2024

Deposition and Exhibits of [redacted], April 19, 2024

Deposition and Exhibits of [redacted]., April 25, 2024

Deposition and Exhibits of [redacted], April 12, 2024

All available deposition transcripts and exhibits within the matter of USA v. Google, Case Number: 1:23-cv-00108-LMB-JFA, including:

Deposition and Exhibits of [redacted] August, 16 2023

Deposition and Exhibits of [redacted] (November 14-15, 2023)

Deposition and Exhibits of [redacted] (August 11, 2023)

Deposition and Exhibits of [redacted] (November 2, 2023)

Deposition and Exhibits of [redacted] September 1, 2023

Deposition and Exhibits of [redacted] (April 1, 2024)

Deposition and Exhibits of [redacted] (November 3, 2024)

Deposition and Exhibits of [redacted] (April 29, 2024)

Deposition and Exhibits of [redacted], September 29, 2023

Deposition and Exhibits of [redacted] August 29, 2023

Deposition and Exhibits of [redacted] (August 16, 2023)

Deposition and Exhibits of [redacted] (August 16, 2023)

Deposition and Exhibits of [redacted] (November 7, 2023)

Deposition and Exhibits of [redacted] (November 7, 2023)

Deposition and Exhibits of [redacted] September 6, 2023

Deposition and Exhibits of [redacted] September 8, 2023

Deposition and Exhibits of [redacted] September 29, 2024

Deposition and Exhibits of [redacted] (November 9, 2023)

Deposition and Exhibits of [redacted] (November 9, 2023)

Deposition and Exhibits of [redacted] September 5, 2023

Deposition and Exhibits of [redacted] September 26, 2023

Deposition and Exhibits of [redacted], September 8, 2023

Deposition and Exhibits of [redacted], September 26, 2023

Deposition and Exhibits of [redacted] (November 15, 2023)

Deposition and Exhibits of [redacted] (November, 11, 2023)

Deposition and Exhibits of [redacted] (November 14, 2023)

Deposition and Exhibits of [redacted] August 9, 2023

Deposition and Exhibits of [redacted] August 31, 2023

Deposition and Exhibits of [redacted] (April 17, 2024)

Deposition and Exhibits of [redacted] September 22, 2023

Deposition and Exhibits of [redacted] September 28, 2023

Deposition and Exhibits of [redacted] September 8, 2023

Deposition and Exhibits of [redacted], September 21, 2023

Deposition and Exhibits of [redacted] (October 10, 2023 and November 8, 2023)

Deposition and Exhibits of [redacted] (October 10, 2023)

Deposition and Exhibits of [redacted] (October 30, 2023)

Deposition and Exhibits of [redacted], August 25, 2023

Deposition and Exhibits of [redacted], August 25, 2023

Deposition and Exhibits of [redacted] September 22, 2023

Deposition and Exhibits of [redacted] (November 14, 2023)

Deposition and Exhibits of [redacted] (30B6 errata only) (November 14, 2023)

Deposition and Exhibits of [redacted] (November 11, 2023)

Deposition and Exhibits of [redacted] (November 3, 2023)

Deposition and Exhibits of [redacted] (November 3, 2024)

Deposition and Exhibits of [redacted] (30(b)6) (November 14, 2023)

Deposition and Exhibits of [redacted] August 29, 2023

Deposition and Exhibits of [redacted] October 26, 2023

Deposition and Exhibits of [redacted] (August 29, 2023)

Deposition and Exhibits of [redacted] (August 15, 2023)

Deposition and Exhibits of [redacted] (April 3, 2024)

Deposition and Exhibits of [redacted], July 28, 2023

Deposition and Exhibits of [redacted] (November 16, 2023)

Deposition and Exhibits of [redacted] August 23, 2023

Deposition and Exhibits of [redacted] September 28, 2023

Google's First Amended Responses and Objections to Plaintiff's Third Set of Interrogatories (May 24, 2024)

Google's Response to Topic 45 of Plaintiff's 30(b)(6) Notice Served February 21, 2024 (As Narrowed by the Parties May 7, 2024 agreement)

Google's Responses and Objections to Plaintiff's Second Set of Interrogatories (April 8, 2024)

Plaintiff States Fourth Amended Complaint (May 5, 2023)

The Plaintiff States' Seventh Amended Responses & Objections to Google LLC's First Set of Interrogatories (May 3, 2024)

c. Expert Reports & Declarations

All available expert reports (with redactions) within the matter of USA v. Google, Case Number: 1:23-cv-00108-LMB-JFA, including:

Declarations of Google Employees

Declaration of [redacted] in support of Google's Objections to Plaintiffs' 30(b)(6) topic 55

2023.12.22 Expert Report of Gabriel Weintraub, GOOG-AT-MDL-C-000018734

2023.12.22 Expert Report of R. Ravi, GOOG-AT-MDL-C-000019017

2023.12.22 Expert Report of Robin S. Lee, GOOG-AT-MDL-C-000019273

2023.12.22 Expert Report of Rosa Abrantes-Metz, GOOG-AT-MDL-C-000019786

2023.12.22 Expert Report of Thomas S. Respess, GOOG-AT-MDL-C-000020106

2023.12.22 Expert Report of Timothy Simcoe, GOOG-AT-MDL-C-000020274

2024.01.13 Errata to Abrantes-Metz Expert Report, GOOG-AT-MDL-C-000020435

2024.01.13 Errata to Ravi Expert Report, GOOG-AT-MDL-C-000020437

2024.01.13 Errata to Respess Expert Report, GOOG-AT-MDL-C-000020440

2024.01.13 Errata to Simcoe Expert Report, GOOG-AT-MDL-C-000020467

2024.01.13 Errata to Weintraub Expert Report, GOOG-AT-MDL-C-000020471

2024.01.23 Chevalier Expert Report, GOOG-AT-MDL-C-000020474

2024.01.23 Ferrante Expert Report, GOOG-AT-MDL-C-000020714

2024.01.23 Ghose Expert Report, GOOG-AT-MDL-C-000020767

2024.01.23 Israel Expert Report, GOOG-AT-MDL-C-000021036

2024.01.23 Milgrom Expert Report, GOOG-AT-MDL-C-000021794

2024.01.23 Rinard Expert Report, GOOG-AT-MDL-C-000022191

2024.01.23 Shirky Expert Report, GOOG-AT-MDL-C-000022229

2024.01.23 Simonson Expert Report, GOOG-AT-MDL-C-000022290

2024.01.23 Skinner Expert Report, GOOG-AT-MDL-C-000022948

2024.02.13 Expert Rebuttal Report of Adoria Lim, GOOG-AT-MDL-C-000023002

2024.02.13 Expert Rebuttal Report of Gabriel Weintraub, GOOG-AT-MDL-C-000023226

2024.02.13 Expert Rebuttal Report of Kenneth Wilbur, GOOG-AT-MDL-C-000023322

2024.02.13 Expert Rebuttal Report of R. Ravi, GOOG-AT-MDL-C-000023435

2024.02.13 Expert Rebuttal Report of Robin S. Lee, GOOG-AT-MDL-C-000023516

2024.02.13 Expert Rebuttal Report of Rosa Abrantes-Metz, GOOG-AT-MDL-C-000023887

2024.02.13 Expert Rebuttal Report of Timothy Simcoe, GOOG-AT-MDL-C-000024064

2024.02.13 Expert Rebuttal Report of Wayne Hoyer, GOOG-AT-MDL-C-000024138

2024.02.13 Expert Rebuttal Report of Wenke Lee, GOOG-AT-MDL-C-000024270

2024.02.16 Errata to Ravi Rebuttal Report, GOOG-AT-MDL-C-000024387

2024.02.20 Errata to Simcoe Rebuttal Report, GOOG-AT-MDL-C-000024389

2024.02.23 Errata to Weintraub Rebuttal Report, GOOG-AT-MDL-C-000024390

2024.02.23 Supplemental Errata to Weintraub Expert Report, GOOG-AT-MDL-C-000024391

2024.02.24 Errata to Wilbur Rebuttal Report, GOOG-AT-MDL-C-000024392

2024.02.26 Errata to Hoyer Rebuttal Report, GOOG-AT-MDL-C-000024397

2024.02.28 Errata to Abrantes-Metz Rebuttal Report, GOOG-AT-MDL-C-000024399

2024.03.04 Expert Supplemental Report of Robin S. Lee, GOOG-AT-MDL-C-000024403

2024.03.08 Consolidated Errata to Lee Rebuttal Report, GOOG-AT-MDL-C-000024436

2024.01.13 Expert Report of Weintraub Errata, GOOG-AT-MDL-C-000040965

2024.01.13 Expert Report of Simcoe Errata, GOOG-AT-MDL-C-000040961

2024.01.13 Expert Report of Respess Errata_with Figure Errata_Redacted, GOOG-AT-MDL-C-000040934

2024.01.13 Expert Report of R Ravi Errata, GOOG-AT-MDL-C-000040931

2024.01.13 Expert Report of Abrantes-Metz Errata, GOOG-AT-MDL-C-000040929

2024.03.08 Consolidated Errata to Lee Rebuttal Report, GOOG-AT-MDL-C-000040926

2024.03.04 Expert Supplemental Report of Robin S. Lee, PhD, GOOG-AT-MDL-C-000040893

2024.02.28 Rebuttal Report Errata of Rosa Abrantes-Metz Signed, GOOG-AT-MDL-C-000040889

2024.02.25 Expert Rebuttal Report of Hoyer Errata, GOOG-AT-MDL-C-000040887

2024.02.24 Wilbur Rebuttal Errata, GOOG-AT-MDL-C-000040882

2024.02.23 Weintraub Rebuttal Report Errata, GOOG-AT-MDL-C-000040881

2024.02.23 Expert Report of Weintraub Supplemental Errata, GOOG-AT-MDL-C-000040880

2024.02.20 Errata to Simcoe Rebuttal Report, GOOG-AT-MDL-C-000040879

2024.02.16 Errata to Ravi Rebuttal Report (Highly Confidential), GOOG-AT-MDL-C-000040877

2024.02.13 Rebuttal Report of Rosa Abrantes-Metz, GOOG-AT-MDL-C-000040700

2024.02.13 Expert Report of Wenke Lee, GOOG-AT-MDL-C-000040583

2024.02.13 Expert Rebuttal Report of Wayne Hoyer, GOOG-AT-MDL-C-000040451

2024.02.13 Expert Rebuttal Report of Timothy Simcoe_Redacted, GOOG-AT-MDL-C-000040377

2024.02.13 Expert Rebuttal Report of Robin S. Lee_Redacted, GOOG-AT-MDL-C-000040006

2024.02.13 Expert Rebuttal Report of R Ravi, GOOG-AT-MDL-C-000039925

2024.02.13 Expert Rebuttal Report of Kenneth Wilbur_Redacted, GOOG-AT-MDL-C-000039812

2024.02.13 Expert Rebuttal Report of Gabriel Weintraub_Redacted, GOOG-AT-MDL-C-000039716

2024.02.13 Expert Rebuttal Report of Adoria Lim_Redacted, GOOG-AT-MDL-C-000039492

2024.01.23 Expert Report of William Clay Shirky, GOOG-AT-MDL-C-000039431

2024.01.23 Expert Report of Paul R. Milgrom, GOOG-AT-MDL-C-000039034

2024.01.23 Expert Report of Martin C. Rinard, GOOG-AT-MDL-C-000038996

2024.01.23 Expert Report of Mark A. Israel_Redacted, GOOG-AT-MDL-C-000038238

2024.01.23 Expert Report of Judith A. Chevalier_Redacted, GOOG-AT-MDL-C-000037998

2024.01.23 Expert Report of Itamar Simonson, GOOG-AT-MDL-C-000037340

2024.01.23 Expert Report of Douglas Skinner, GOOG-AT-MDL-C-000037286

2024.01.23 Expert Report of Anthony J. Ferrante, GOOG-AT-MDL-C-000037233

2024.01.23 Expert Report of Anindya Ghose_Redacted, GOOG-AT-MDL-C-000036954

2023.12.22 Expert Report of Timothy Simcoe_Redacted, GOOG-AT-MDL-C-000036793

2023.12.22 Expert Report of Thomas Respess_Redacted, GOOG-AT-MDL-C-000036625

2023.12.22 Expert Report of Rosa Abrantes-Metz_Redacted, GOOG-AT-MDL-C-000036305

2023.12.22 Expert Report of Robin S. Lee, PhD_Redacted, GOOG-AT-MDL-C-000035792

2023.12.22 Expert Report of R Ravi_Redacted, GOOG-AT-MDL-C-000035536

2023.12.22 Expert Report of Gabriel Weintraub_Redacted, GOOG-AT-MDL-C-000035253

B. Documents from Production

[redacted]

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GOOG-AT-MDL-000009165
GOOG-AT-MDL-000010082
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GOOG-TEX-01244428
GOOG-TEX-01269873
GOOG-TEX-01279945
GOOG-TEX-01280212
[redacted]

C. Public Sources

Abhilasha, headerbidding, "Google Ad Manager or Google Ad Manager 360 – What Should a Publisher Choose?" https://headerbidding.co/google-ad-manager-vs-ad-manager-360/. Accessed May 23, 2024.

Adjust, "What is an impression?" https://www.adjust.com/glossary/impression/. Accessed April 23, 2024.

Adjust, "What is native advertising," https://www.adjust.com/glossary/native-advertising/. Accessed May 23, 2024.

AdMeld, "Superior Technology, Superior Results," https://web.archive.org/web/20101225163051/http://www.admeld.com/technology.html. Accessed May 31, 2024.

Amazon Ads, "Ad Servers and how they work," https://advertising.amazon.com/library/guides/ad-server. Accessed June 5, 2024.

Amazon Ads, "What is an ad exchange? Learn how they work," https://advertising.amazon.com/library/guides/ad-exchange. Accessed June 5, 2024.

Amazon Customer Service, "About Cookies" (January 1, 2020). https://www.amazon.com/gp/help/customer/display.html?nodeId=GV. Accessed June 5, 2024.

Amazon, "Transparent Ad Marketplace," https://aps.amazon.com/aps/transparent-ad-marketplace/. Accessed May 23, 2024.

Aqeel, W., Bhattacherjee, D., et al., "Untangling Header Bidding Lore: Some Myths, Some Truths, and Some Hope," In: Sperotto, A., Dainotti, A., Stiller, B. (eds) Passive and Active Measurement. PAM 2020. Lecture Notes in Computer Science, vol 12048. Springer, Cham. https://doi.org/10.1007/978-3-030-44081-7_17.

Australian Competition & Consumer Commission, "Digital advertising services inquiry," (August 2021), https://www.accc.gov.au/system/files/Digital%20advertising%20services%20inquiry%20-%20final%20report.pdf. Accessed May 24, 2024rAuthorized Buyers Help, "Authorized Buyers Overview," https://support.google.com/authorizedbuyers/answer/6138000. Accessed May 30, 2024.

Authorized Buyers Help, "Introduction to real-time-bidding (RTB)," https://support.google.com/authorizedbuyers/answer/6136272. Accessed May 23, 2024.

Barth A., Internet Engineering Task Force (IETF) Request for Comments (RFC) 6265, "HTTP State Management Mechanism" (April 2011). https://datatracker.ietf.org/doc/html/rfc6265. Accessed June 5, 2024.

Bellack J., Google Ad Manager, "Introducing Google Ad Manager," https://blog.google/products/admanager/introducing-google-ad-manager/. Accessed May 23, 2024.

Bellack J., Google Ad Manager, "Introducing Google Ad Manager," https://support.google.com/admanager/answer/9298008. Accessed May 23, 2024.

Bigabid, "Whaterfall vs. Header Bidding, Everything you Need to Know," https://www.bigabid.com/waterfall-vs-header-bidding/. Accessed May 23, 2024.

Bigler J., "Rolling out first price auctions to Google Ad Manager partners," https://blog.google/products/admanager/rolling-out-first-price-auctions-google-ad-manager-partners/. Accessed May 23, 2024.

Bigler, J., "An update on first price auctions for Google Ad Manager," https://blog.google/products/admanager/update-first-price-auctions-google-ad-manager/. Accessed May 30, 2024.

Campaign Manager 360 Help, "Overview of Campaign Manager 360," https://support.google.com/campaignmanager/answer/2709362. Accessed June 6, 2024.

Cheikha E., Outbrain, (2023), "The Remarketing Guide for Dummies," https://www.outbrain.com/blog/remarketing-guide/. Accessed May 23, 2024.

Clearcode, "Ad slot," https://clearcode.cc/glossary/ad-slot-definition/. Accessed May 23, 2024.

Cox, S., "Announcing Exchange Bidding open beta," https://blog.google/products/admanager/announcing-exchange-bidding-open-beta/. Accessed May 23, 2024.

Criteo, "What is the difference between CPC and CPM?" https://www.criteo.com/blog/whats-difference-cpc-cpm/. Accessed May 23, 2024.

Description of capabilities of DSPs, "What is a demand-side platform (DSP)?" https://www.adjust.com/glossary/demand-side-platform/. Accessed May 23, 2024.

Digiday, "'An ad tech urban legend': An oral history of how header bidding became digital advertising's hottest buzzword," https://digiday.com/media/header-bidding-oral-history/. Accessed May 23, 2024.

Display & Video 360 Help, "Introducing Google Marketing Platform," https://support.google.com/displayvideo/answer/9015629. Accessed June 4, 2024.

Display & Video 360 Help, "Managing exchanges," https://support.google.com/displayvideo/answer/9230278?hl=en. Accessed June 6, 2024.

Display & Video 360 Help, "Supported display exchanges," https://support.google.com/displayvideo/table/3267029?hl=en. Accessed June 6, 2024.

Display & Video 360 Help, "What's new: July 2023," https://support.google.com/displayvideo/answer/13840246. Accessed May 23, 2024.

DV360: Display & Video 360 Help, "Create a campaign," https://support.google.com/displayvideo/answer/7205081. Accessed May 21, 2024.

Examples of set-up pages from different buyside tools: Trade Desk: Partner portal, "Campaign," https://partner.thetradedesk.com/v3/portal/api/doc/Campaign. Accessed May 21, 2024.

Flanagan J., adtaxi, "The Origins and Progression of Real-Time Bidding," https://www.adtaxi.com/blog/origins-progression-real-time-bidding/. Accessed May 23, 2024.

GAM (DFP and AdX), https://admanager.google.com/home. Accessed May 23, 2024.

Ganz E., ADCORE Blog, "What is DV360 and How to Start Advertising," https://www.adcore.com/blog/what-is-dv360-and-how-to-start-advertising. Accessed May 23, 2024.

Google Ad Manager Help , "Get started with ads in Google Ad Manager," https://support.google.com/admanager/answer/6027116. Accessed May 23, 2024.

Google Ad Manager Help, "About line items," https://support.google.com/admanager/answer/9405477. Accessed May 23, 2024.

Google Ad Manager Help, "About publisher provided identifiers," https://support.google.com/admanager/answer/2880055. Accessed May 23, 2024.

Google Ad Manager Help, "Ad Manager report metrics," https://support.google.com/admanager/table/7568664. Accessed May 23, 2024.

Google Ad Manager Help, "Add new line items," https://support.google.com/admanager/answer/82236. Accessed June 4, 2024.

Google Ad Manager Help, "Advertising with Google Ad Manager," https://support.google.com/admanager/answer/6022000. Accessed May 23, 2024.

Google Ad Manager Help, "Compare Ad Manager, AdSense, and AdMob," https://support.google.com/admanager/answer/9234653. Accessed May 23, 2024.

Google Ad Manager Help, "Create a new report," https://support.google.com/admanager/answer/2643320. Accessed May 23, 2024.

Google Ad Manager Help, "Create and manage yield groups," https://support.google.com/admanager/answer/7390828. Accessed May 23, 2024.

Google Ad Manager Help, "Enable remnant line item serving mode," https://support.google.com/admanager/answer/11469847. Accessed May 23, 2024.

Google Ad Manager Help, "Generate ad tags," https://support.google.com/admanager/answer/177207. Accessed May 23, 2024.

Google Ad Manager Help, "House line items," https://support.google.com/admanager/answer/79305. Accessed May 23, 2024.

Google Ad Manager Help, "Introduction to Open Bidding," https://support.google.com/admanager/answer/7128453. Accessed May 23, 2024.

Google Ad Manager Help, "Line item types and priorities," https://support.google.com/admanager/answer/177279. Accessed May 23, 2024.

Google Ad Manager Help, "Network line items," https://support.google.com/admanager/answer/171909. Accessed May 23, 2024.

Google Ad Manager Help, "Optimize pricing to reflect inventory's value," https://support.google.com/admanager/answer/12243638?hl=en. Accessed June 7, 2024.

Google Ad Manager Help, "Overview of Google Publisher Tag," https://support.google.com/admanager/answer/181073. Accessed May 30, 2024.

Google Ad Manager Help, "Payment rules," https://support.google.com/admanager/answer/2671028. Accessed May 23, 2024.

Google Ad Manager Help, "Programmatic Guaranteed vs. Preferred Deals," https://support.google.com/admanager/answer/7637485. Accessed May 23, 2024.

Google Ad Manager Help, "Report types in Ad Manager," https://support.google.com/admanager/answer/10117711. Accessed May 23, 2024.

Google Ad Manager Help, "System maximums and limits," https://support.google.com/admanager/answer/1628457. Accessed May 24, 2024.

Google Ad Manager Help, "Target CPM," https://support.google.com/admanager/answer/10357452?hl=en. Accessed June 7, 2024.

Google Ad Manager Help, "Value CPM," https://support.google.com/admanager/answer/177222. Accessed May 23, 2024.

Google Ad Manager, "Unified First-Price Auction – Best practices," https://services.google.com/fh/files/misc/unified_first-price_auction_best_practices.pdf. Accessed May 23, 2024.

Google Ad Manager, "What are creatives?" https://support.google.com/admanager/answer/3185155?hl=en. Accessed June 7, 2024.

Google Ads Help, "About bidding features in Display campaigns," https://support.google.com/google-ads/answer/2947304. Accessed May 23, 2024.

Google Ads Help, "About the Display Network ad auction," https://support.google.com/google-ads/answer/2996564. Accessed May 21, 2024.

Google Ads Help, "Create a Search campaign," https://support.google.com/google-ads/answer/9510373. Accessed May 23, 2024.

Google Ads Help, "Fix low traffic or conversion rate for Target CPA," https://support.google.com/google-ads/answer/638515. Accessed May 23, 2024.

Google Ads Help, "Maximize clicks: Definition," https://support.google.com/google-ads/answer/6336101. Accessed May 23, 2024.

Google Ads Help, "Maximum CPC bid: Definition," https://support.google.com/google-ads/answer/6326. Accessed May 23, 2024.

Google Ads, "How to set up your first Google Ads campaign," https://ads.google.com/intl/en_us/home/how-it-works/. Accessed May 23, 2024.

Google Ads, "Target cost-per-thousand impressions (tCPM)," https://support.google.com/google-ads/answer/9158634. Accessed May 24, 2024.

Google Ads, "Unified pricing rules," https://support.google.com/admanager/answer/9298008. Accessed May 23, 2024.

Google Ads, https://ads.google.com. Accessed May 23, 2024.

Google Ads, https://ads.google.com/intl/en_us/home/campaigns/search-ads/. Accessed May 23, 2024.

Google Ads Help, "About Display ads and the Google Display Network," https://support.google.com/google-ads/answer/2404190. Accessed June 6, 2024.

Google Ads Help, "Create a campaign," https://support.google.com/google-ads/answer/6324971. Accessed May 21, 2024.

Google for Developers, "Cookie Matching | Real-time Bidding," https://developers.google.com/authorized-buyers/rtb/cookie-guide. Accessed June 7, 2024.

Google Marketing Platform, "Improve Campaign performance with new automated bidding solutions," https://blog.google/products/marketingplatform/360/improve-campaign-performance-new-automated-bidding-solutions/. Accessed May 23, 2024.

Google Marketing Platform, https://marketingplatform.google.com/about/display-video-360/. Accessed May 23, 2024.

Google Publisher Tag, "Get Started with Google Publisher Tag," https://developers.google.com/publisher-tag/guides/get-started. Accessed May 23, 2024.

Google, "3 questions businesses should ask when they get started with Google Ads," https://blog.google/outreach-initiatives/small-business/small-business-google-ads-tips/. Accessed May 23, 2024.

Google, "About campaign goal types," https://support.google.com/admob/answer/9152820. Accessed May 23, 2024.

Google, "Ad competition with dynamic allocation," https://support.google.com/admanager/answer/3721872. Accessed May 23, 2024.

Google, "Clickthrough rate (CTR): Definition," https://support.google.com/google-ads/answer/2615875. Accessed May 23, 2024.

Google, "Control ad loading and refresh," https://developers.google.com/publisher-tag/guides/control-ad-loading. Accessed May 23, 2024.

Google, "Difference between AdSense and Google Ads," https://support.google.com/adsense/answer/76231. Accessed May 23, 2024.

Google, "Generate Ad Exchange Ad Tags," https://support.google.com/admanager/answer/7501422. Accessed May 30, 2024.

Google, "Get started with key-values," https://support.google.com/admanager/answer/188092. Accessed May 30, 2024.

Google, "Get started with Open Bidding," https://support.google.com/admanager/answer/7128657. Accessed May 30, 2024.

Google, "Glossary," https://support.google.com/admanager/table/7636513. Accessed May 23, 2024.

Google, "Google Expands Advertising Monetization Program for Websites," https://googlepress.blogspot.com/2003/06/google-expands-advertising-monetization.html. Accessed May 23, 2024.

Google, "Google Launches Self-Service Advertising Program," https://googlepress.blogspot.com/2000/10/google-launches-self-service.html. Accessed May 23, 2024.

Google, "Google to Acquire DoubleClick," https://googlepress.blogspot.com/2007/04/google-to-acquire-doubleclick_13.html. Accessed May 23, 2024.

Google, "Helping publishers get the most from display advertising with AdmeId," https://googleblog.blogspot.com/2011/06/helping-publishers-get-most-from.html. Accessed June 3, 2024.

Google, "How Open Bidding works," https://support.google.com/admanager/answer/7128958. Accessed May 23, 2024.

Google, "How we decide which ad is served," https://support.google.com/admanager/answer/11204312. Accessed May 23, 2024.

Google, "Introducing the next generation of the DFP ad tag," https://doubleclick-publishers.googleblog.com/2011/10/introducing-next-generation-of-dfp-ad.html. Accessed June 4, 2024.

Google, "Manual CPC bidding," https://support.google.com/google-ads/answer/2390250. Accessed May 24, 2024.

Google, "OpenRTB Integration," https://developers.google.com/authorized-buyers/rtb/openrtb-guide. Accessed May 23, 2024.

Google, "Optimized competition," https://support.google.com/admanager/answer/7422526. Accessed May 23, 2024.

Google, "Targeting types," https://support.google.com/admanager/answer/2884033. Accessed May 24, 2024.

Google, "Third-party ad serving (3PAS)," https://support.google.com/authorizedbuyers/answer/2961247. Accessed May 23, 2024.

Google, "Ad selection white paper," https://support.google.com/admanager/answer/1143651?sjid=16185194441614631351-NA. Accessed June 6, 2024.

Greenfield I., mntn, "Ad Exchange: What Is It and How Does it Work?" https://mountain.com/blog/what-is-an-ad-exchange/. Accessed May 23, 2024.

Greenfield I., mntn, "Demand Side Platform (DSP): What Is It and How Does It Work?" https://mountain.com/blog/demand-side-platform/. Accessed May 23, 2024.

headerbidding, "Price Floor Optimization – a Guide for Publishers," https://headerbidding.co/price-floor-optimization/. Accessed May 23, 2024.

IAB Australia, "Auction Mechanics Handbook v2.0" (February 2019), https://iabaustralia.com.au/wp-content/uploads/2019/02/Auction_Mechanics_V2.0_Feb2019.pdf. Accessed June 6, 2024.

IAB Tech Lab, "OpenRTB," https://iabtechlab.com/standards/openrtb/. Accessed May 23, 2024.

Incubeta DQ&A, "DQ&A Webinar: Google Ad Exchange Ad Manager 360 [Advanced]" (May 3, 2019) https://www.youtube.com/watch?v=UpXq66ME1gQ.

Jain A., Tatvic, "What is the Difference between DV360 and Google Ads?" https://www.tatvic.com/blog/what-is-the-difference-between-dv360-and-google-ads/. Accessed May 23, 2024.

Kaspersky, "What are Cookies?" https://usa.kaspersky.com/resource-center/definitions/cookies. Accessed May 23, 2024.

Kaspersky, "What is an IP Address – Definition and Explanation," https://usa.kaspersky.com/resource-center/definitions/what-is-an-ip-address. Accessed May 23, 2024.

Khor N., Publift, "What is a Supply-Side Platform?" https://www.publift.com/adteach/what-is-a-supply-side-platform. Accessed May 23, 2024.

Khor N., Publift, "What is Programmatic Advertising? How Does it Work?" https://www.publift.com/adteach/what-is-programmatic-advertising. Accessed May 23, 2024.

Maciej, Z. and Mike, S., "What is Waterfalling and How Does it Work?" https://clearcode.cc/blog/what-is-waterfalling/. Accessed May 23, 2024.

Medium, "Google Ads vs. DV360: Which One is Better?" https://medium.com/@contact_10971/google-ads-vs-dv360-which-one-is-better-8fbd3a883787. Accessed May 23, 2024.

Microsoft Edge Team, Microsoft Edge Blog, "New Privacy-Preserving Ads API coming to Microsoft Edge" (March 5, 2024), https://blogs.windows.com/msedgedev/2024/03/05/new-privacy-preserving-ads-api/. Accessed June 6, 2024.

Mills, C., Mozilla, "Saying goodbye to third-party cookies in 2024," https://developer.mozilla.org/en-US/blog/goodbye-third-party-cookies/. Accessed May 24, 2024.

Mozilla Support Firefox Help, "Cookies - Information that websites store on your computer" (July 29, 2023), https://support.mozilla.org/en-US/kb/cookies-information-websites-store-on-your-computer. Accessed June 5, 2024.

Mozilla, "CSS basics," https://developer.mozilla.org/en-US/docs/Learn/Getting_started_with_the_web/CSS_basics. Accessed May 23, 2024.

Mozilla, "HTML basics," https://developer.mozilla.org/en-US/docs/Learn/Getting_started_with_the_web/HTML_basics. Accessed May 23, 2024.

Mozilla, "HTML elements reference," https://developer.mozilla.org/en-US/docs/Web/HTML/Element. Accessed May 23, 2024.

Mozilla, "JavaScript basics," https://developer.mozilla.org/en-US/docs/Learn/Getting_started_with_the_web/JavaScript_basics. Accessed May 23, 2024.

Munro B., Publift, "Ultimate Guide to Ad Tags," https://www.publift.com/blog/ultimate-guide-to-ad-tags. Accessed May 23, 2024.

Munro B., Publift, "What is an Ad Exchange and How Does it Work?" https://www.publift.com/blog/what-is-an-ad-exchange. Accessed May 23, 2024.

Munro B., Publift, "What is Programmatic Direct," https://www.publift.com/blog/what-is-programmatic-direct. Accessed April 11, 2024.

Nguyen S., all about cookies, "What are Internet Cookies and How Are They Used?" https://allaboutcookies.org/what-is-a-cookie. Accessed May 23, 2024.

Novatska K., Cepom, "What is an Ad Tag and How to Generate It," https://epom.com/blog/ad-server/what-is-an-ad-tag. Accessed May 23, 2024.

playwire, "Ad Server vs. Ad Network," https://www.playwire.com/blog/ad-server-vs-ad-network. Accessed May 23, 2024.

Postman, "What are HTTP headers," https://blog.postman.com/what-are-http-headers/. Accessed May 23, 2024.

Prebid, "Ad Unit Reference," https://docs.prebid.org/dev-docs/adunit-reference.html. Accessed May 23, 2024.

Prebid, "Basic Prebid.js Example," https://docs.prebid.org/dev-docs/examples/basic-example.html. Accessed May 23, 2024.

Prebid, "Getting Started for Developers," https://docs.prebid.org/dev-docs/getting-started.html. Accessed May 24, 2024.

Prebid, "Hosting a Prebid Server Cluster," https://docs.prebid.org/prebid-server/hosting/pbs-hosting.html. Accessed May 24, 2024.

Prebid, "Introduction to Prebid," https://docs.prebid.org/overview/intro.html. Accessed May 23, 2024.

Prebid, "Key Values," https://docs.prebid.org/adops/key-values.html. Accessed May 23, 2024.

Prebid, "pbjs.addAdUnits(Array|Object)," https://docs.prebid.org/dev-docs/publisher-api-reference/addAdUnits.html. Accessed May 23, 2024.

Prebid, "pbjs.getBidResponses()," https://docs.prebid.org/dev-docs/publisher-api-reference/getBidResponses.html. Accessed May 23, 2024.

Prebid, "pbjs.requestBids(requestObj)," https://docs.prebid.org/dev-docs/publisher-api-reference/requestBids.html. Accessed May 23, 2024.

Prebid, "pbjs.setTargetingForGPTAsync([codeArr], customSlotMatching)," https://docs.prebid.org/dev-docs/publisher-api-reference/setTargetingForGPTAsync.html. Accessed May 23, 2024.

Prebid, "Prebid Server Overview," https://docs.prebid.org/prebid-server/overview/prebid-server-overview.html. Accessed May 24, 2024.

Prebid, "Price Floors Module," https://docs.prebid.org/dev-docs/modules/floors.html. Accessed June 7, 2024.

Prebid, "Price Granularity," https://docs.prebid.org/adops/price-granularity.html. Accessed June 4, 2024.

Prebid, "Server-Side Header Bidding with Prebid.js," https://docs.prebid.org/dev-docs/pbsBidAdapter-video-overview.html. Accessed May 24, 2024.

Prebid, "Troubleshooting Prebid.js," https://docs.prebid.org/troubleshooting/troubleshooting-guide.html. Accessed May 23, 2024.

Privacy Sandbox, "Prepare for third-party cookie restrictions," https://developers.google.com/privacy-sandbox/3pcd. Accessed May 21, 2024.

Programmads, "Why use DV360 instead of Google Ads?" https://programmads.com/project/why-use-display-video-360-instead-of-google-ads/. Accessed May 23, 2024.

Schonfeld E., techcrunch, "Google Confirms Invite Media Acquisition, Brings Bidding to Display Ads," https://techcrunch.com/2010/06/03/google-confirms-invite-media/. Accessed May 23, 2024.

Search Ads 360 Help, "Set up remarketing lists for search ads," https://support.google.com/searchads/answer/7196986?hl=en. Accessed June 7, 2024.

Seth A., adpushup, "Programmatic Deals vs. Direct Deals – Simplified Advertising Comparison," https://www.adpushup.com/blog/programmatic-vs-direct-deal/. Accessed May 23, 2024.

Seth A., adpushup, "What are Ad Tags and Why Do They Matter," https://www.adpushup.com/blog/ad-tags/. Accessed May 23, 2024.

Sweeney M., clearcode, "What is a Demand-Side Platform (DSP) and How Does It Work?" https://clearcode.cc/blog/demand-side-platform/. Accessed May 23, 2024.

Sweeney M., Zawadzinski M., clearcode, "What is an Ad Server and How does it work?" https://clearcode.cc/blog/what-is-an-ad-server/. Accessed May 23, 2024.

Taylor, R., Criteo, "Header Bidding Demystified: Client-Side vs. Server-Side," https://www.criteo.com/blog/header-bidding-demystified-client-side-vs-server-side/. Accessed May 23, 2024.

The Trade Desk, "Glossary," https://www.thetradedesk.com/us/glossary. Accessed June 5, 2024.

Titone T., ad tech explained, "Real-Time Bidding Explained – How do ad auctions work?" https://adtechexplained.com/real-time-bidding-explained/. Accessed May 30, 2024.

Tyler B., "Are Ad Demand Sources Responsible For High Website Revenue," https://www.ezoic.com/ad-demand-sources-website-revenue/. Accessed January 18, 2024.

Urwin M., builtin, "Adtech Definition," https://builtin.com/adtech-martech. Accessed May 23, 2024.

Vaibhav P., aniview, "What is an ad server? How does ad serving work?" https://aniview.com/what-is-an-ad-server-how-does-ad-serving-work/. Accessed May 23, 2024.

Will K., " Cost Per Thousand (CPM) Definition and Its Role in Marketing," https://www.investopedia.com/terms/c/cpm.asp. Accessed January 18, 2024.

Zaiceva A., "First-Price vs. Second-Price Auction | Difference Explained," https://setupad.com/blog/first-price-vs-second-price-auction/. Accessed January 31, 2024.

Zaiceva A., "Google Publisher Tag (GPT): A Complete Beginner's Guide," https://setupad.com/blog/google-gpt/. Accessed May 23, 2024.

Zaiceva A., setupad, "Google AdX vs. Google AdSense | Difference Explained," https://setupad.com/blog/adsense-vs-ad-exchange/. Accessed May 30, 2024.

Zaiceva A., setupad, "What is an Ad Server & 10 Best Ad Servers for Publishers," https://setupad.com/blog/ad-server/. Accessed May 23, 2024.

Zaiceva A., Setupad, "What is Header Bidding? | A Complete Guide for Publishers," https://setupad.com/blog/what-is-header-bidding/. Accessed May 23, 2024.

Zaiceva, A., Setupad, "Header Bidding vs Waterfall | Differences Explained," https://setupad.com/blog/header-bidding-vs-waterfall/. Accessed May 23, 2024.

Zawadzinski M., Sweeney M., clearcode, "What Is an Ad Network and How Does It Work?" https://clearcode.cc/blog/what-is-an-ad-network-and-how-does-it-work/. Accessed May 23, 2024.

XVIII. APPENDIX D: CURRICULUM VITAE OF DR. JACOB HOCHSTETLER

[DOCUMENT STARTS ON THE FOLLOWING PAGE]

JACOB HOCHSTETLER, PhD

(940) 765.9451 | jacob.hochstetler@gmail.com | GitHub Profile | LinkedIn | ResearchGate

Education

Ph.D. – Computer Science and Engineering – University of North Texas, Denton, TX – 2021

Dissertation: An Extensible Computing Architecture Design for Connected Autonomous Vehicle System

Advisor: Dr. Song Fu

Master of Science – Computer Science – UNT – 2018

Bachelor of Science – Computer Science – UNT – 2011

Skills

Main (knowledge and daily experience):

- Languages: Go, Python, Ruby, Shell (bash/csh/zsh), TypeScript/JavaScript, LaTeX
- Frameworks: Chef, Ansible, React, VueJS, Vuetify (Material Design), k8s, Prometheus, Rails, gRPC
- Etc.: Lambda, DynamoDB, PostgreSQL, CockroachDB, Argo, Helm, Jenkins, Docker, Terraform, Envoy

Experienced (used in the past):

- Languages: ObjC, Swift, Java, C/C++, Perl, Tcl/Tk, VBScript/PS, R/Shiny
- Frameworks: Bootstrap, SASS, AngularJS, ELK, Django
- Etc.: Percona (MySQL), Hadoop, Solr, Redis, Packer, Splunk, OpenStack, RabbitMQ

Publications

- *Cooperative Mixed Reality Leveraging Edge Computing and Communication* – 5th ACM/IEEE Symposium on Edge Computing (SEC) – 2020
- *Low-latency High-level Data Sharing for Connected and Autonomous Vehicular Networks* – IEEE Intl. Conf. on Industrial Internet (ICII) – 2019
- *An Empirical Study of Quad-Level Cell (QLC) NAND Flash SSDs for Big Data Applications* – IEEE Intl. Conf. on Big Data (Big Data) – 2019
- *Embedded Deep Learning for Vehicular Edge Computing* – 3rd IEEE/ACM Symposium on Edge Computing (SEC) – 2018
- *Reliability Characterization of Solid State Drives in a Scalable Production Datacenter* – IEEE Intl. Conf. on Big Data (Big Data) – 2018
- *Incorporate Proactive Data Protection in ZFS Towards Reliable Storage Systems* – IEEE 16th Intl. Conf. on Dependable Computing (DASC) – 2018
- *Developing Cost-Effective Data Rescue Schemes to Tackle Disk Failures in Data Centers* – Springer Intl. Conf. on Big Data – 2018
- *An Optimal Police Patrol Planning Strategy for Smart City Safety* – IEEE 14th Intl. Conf. on Smart City (SmartCity) – 2016

Clearances & Certifications

- **TS/SCI** – DoD – 1997
- **Counter-intelligence polygraph** – DoD – 1997
- **Full-scope polygraph** – CIA – 2003
- **Security+** – CompTIA – 2010
- **ITILv3 Certified** – AXELOS – 2010
- **Sun Certified System Administrator (SCSA)** – Sun Microsystems – Solaris 8 & 2.6
- **Sun Certified System Support Engineer (SSE)** – Sun Microsystems – 2002
- **Cisco Certified Network Associate (CCNA)** – Cisco – 2000

Litigation Support & Expert Witness Experience

Cellspin Soft, Inc. v. Fitbit, Inc., et al. – Garteiser Honea – CA Northern District, 4:17-cv-05928 2020 to 2021

- *Matter*: Patent Infringement, Digital Data capture with Bluetooth interface
- *Provided*: Seven code reviews

InfoGation Corp. v. Google LLC – Sheridan Ross PC – TX Western District 6:20-cv-0366 2020 to 2022

- *Matter*: Patent Infringement, Mobile Navigation System
- *Provided*: Code review

Tactical Entertainment, LLC v. Krasamo, Inc. – Creedon PLLC – TX 401st District, 401-03246-2017 2019 to 2021

- *Matter*: Software development, Back-end services, APIs, and Networking
- *Provided*: Code review

Teaching Experience

Clinical Assistant Professor, University of North Texas, Denton, TX

- CSCE3055 – *IT Project Management*: Microsoft Project, SDLC, Agile development, Git, Basecamp, Project Finance, Google Analytics.
- CSCE3220 – *Human Computer Interfaces*: UI/UX, Adobe XD, Web Accessibility, iOS UI and Android UI kits.
- CSCE3420 – *Internet Programming*: PHP, JavaScript, Node.js, HTML/CSS, Client/Server architecture, APIs, AWS Lambda.
- CSCE3530 – *Introduction to Computer Networks*: OSI Model: MAC, Ethernet, TCP/IP, Proxies/Load Balancers, Application layer.
- CSCE3550 – *Foundations of Cybersecurity*: Security goals, threats, vulnerabilities. Network, program, and operating system security issues.
- CSCE4350 – *Database Systems*: SQL, MySQL, Object Stores, NoSQL, AWS DynamoDB.
- CSCE4560 – *Secure Electronic Commerce*: Shopping carts/Payment gateways, eCommerce security, PKI, SSL/TLS, AuthZ/AuthN, Blockchain.
- CSCE4600 – *Operating Systems*: system abstraction/virtualization, process/threads concurrency, persistence (resource management), security.
- CSCE5552 – *Cybersecurity Essentials*: Data concealment/obfuscation, system identity/reconnaissance/exploitation, cryptography, data forensics.
- CSCE5585 – *Advanced Network Security*: Firewalls, intrusion prevention/detection systems, network forensics, network pentesting.

Research Experience

University of North Texas, Dependable Computing Systems Lab, Denton, TX

- Data format and protocol end-to-end architecture for connected vehicle data sharing.
- Embedded/Single board computer edge node clustering using Rancher k3s and k3os.
- Autonomous, self-driving system using Nvidia PX2 with Lidar, Radar, and image sensors on a Polaris GEM (with NSF).
- Edge node-style hard-drive deployments using single-board computers embedded in HDD PCBs (in partnership with HP Labs).
- Real-time machine learning with Microsoft HoloLens for augmented reality and a single-board computer for inference.

Los Alamos National Labs, Department of Energy, Trinity, Los Alamos, NM

- Machine learning log HPC analysis.
- Singularity container system to deploy HPC workloads.

Work History

Vice President, Personal Investing, Cloud Engineering [Distinguished Engineer] – Fidelity Investments – Westlake, TX 2022 to Present

- Provided technical oversight to Fidelity's Personal Investing (PI) Platform Engineering teams as a Distinguished Engineer.
- Created app-team level self-service routing based on multiple Envoy routers, both through public and on-premise datacenters.
- Developed "next-gen" Golang skeleton/framework for high-performance (high-TPS) applications.
- Facilitated high-level and cross-business unit architecture design teams.

Clinical Assistant Professor, Department of Computer Science and Engineering – University of North Texas – Denton, TX 2021 to Present

- Taught undergrad and graduate level computer science, information technology, and cybersecurity courses.
- Developed online curriculum for multiple classes.
- Led NSA/NSF GenCyber student and teacher summer camps [2022, 2023].
- Chaired multiple hiring committees, resulting in onboarding eight faculty members.
- Served as Computer Science curriculum program advisor.

Director, Infrastructure as a Service Development/Product Owner/IC – Fidelity Investments – Westlake, TX 2018 to 2022

- Led a "two-pizza team" developing an on-premise cloud management platform with Kanban-style feature delivery.
- Acted as lead individual contributor to application architecture, design, and development.
- Mentored junior developers on best practices in SDLC, CI/CD, and infrastructure automation/orchestration.
- Led stability project in migrating a decade-old legacy Python codebase to Golang.

Principal Software Engineer/Cloud Technologist – Fidelity Investments – Westlake, TX 2016 to 2018

- Maintained API (Python) and UI (Rails/AngularJS) for an on-premise cloud management platform.
- Provided DevOps support for both the cloud management platform and underlying infrastructure (Citrix XenServer, OpenStack, and AWS EC2).
- Developed "Day 0", "1" and "2" automation through Chef and Ansible to meet security, compliance and audit requirements.

Senior Software Engineer – Fidelity Investments – Westlake, TX 2015 to 2016

- Led project to automate end-user SSH PKI Lifecycle Management within Fidelity.
- Developed highly available architecture composed of master-master DB nodes surrounded by "dumb" API and UI nodes.
- Used `fpm` to create packages for Solaris, Red Hat, Debian (Ubuntu), and AIX for seamless user integration (`opensshd/sshd`) with the PKI portal.

UNIX Systems Lead – General Dynamics – SW Asia 2011 to 2014

- Maintained UNIX systems for the US Air Force Central Command Intelligence, Surveillance and Reconnaissance Division.
- Provided Subject Matter Expertise to A6/G6/J6 commands, along with down-range assets.
- Developed real-time, self-service web services to replace business processes for the Change-Advisory Board, increasing delivery to customers.

JWICS Systems/C2 Systems Lead – General Dynamics – SW Asia/HOA/AFG/IRQ 2010 to 2011

- Supported core JWICS hardware/software including VMware, Solaris, NetApp filers, Windows, and Red Hat Enterprise Linux (RHEL).
- Maintained multiple JSTARS Workstations, Approver for Radiant Mercury in training and live environments.

Sun Engineer (Onsite) – General Dynamics – Plano, TX 2007 to 2010

- Provided on-site support to the EDS (later HP) datacenter for Sun Microsystems/Hewlett Packard/General Motors/OnStar.
- Developed in-house application to manage personnel rotations and inventory at all Sun-managed datacenter to meet SLAs.

C2 Systems Administrator – General Dynamics – SW Asia 2006 to 2007

- Installed, configured and maintained Solaris-based Command and Control systems at the Combined Air Operations Center.
- Trained end-users and maintainers on JSWS, Radiant Mercury, and Information Support Server Environment guard.
- Created and maintained Continuity of Operations (COOP) plans and documentation.

GCCS Administrator/COP Manager – General Dynamics – SW Asia 2005 to 2006

- Provided on-site operational and functional support as the Common Operational Picture manager at the Combined Air Operations Center.
- Managed the flow of information between the SIPR, CSV, CENTRIX, GCC+2 networks, Administered DII-COE GCCS cluster on Solaris 2.5.1.
- Manipulated displays and ground, air and sea tracks for local C2PC clients and downstream feeds.

Sun Microsystems Subject Matter Expert Engineer (Onsite SME) – General Dynamics – SW Asia/AFG/IRQ 2004 to 2005

- Conducted hardware and software fault isolation, root cause analysis and repair on Sun Microsystems servers, storage arrays, and workstations.
- Provided continual training to military personnel in the operation of Solaris and Sun Microsystems equipment.

Security Contractor – Academi (formerly Blackwater Security Company) – SW Asia/IRQ 2003 to 2004

- Conducted personal security detail and training operations for the US and Iraqi military.

Field Engineer – General Dynamics – San Jose, CA 2000 to 2002

- Serviced Sun Microsystems equipment at secure (GOV/MIL) and commercial customer sites.
- Developed in-house reporting tools to gather email and SMS messages, parse them for job information, and assign escalation queues.

Counter-Intelligence Agent – US Army 1996 to 2005

- Provided CI duties as a human intelligence (HUMINT) agent to sliced elements.
- Surveilled, interviewed, and interrogated human sources, and analyzed open-source (OSINT) intelligence.
- Engaged in security/force-protection operations involving intelligence collection, processing, producing, and dissemination.

EXHIBIT 4

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS

State of Texas, *et al*.,

Plaintiffs,

v.

Google LLC,

Defendant.

Case No. 4:20-CV-957-SDJ
Hon. Sean D. Jordan

Expert Report of Professor Steven N. Wiggins

July 30, 2024

Table of Contents

I. Introduction

A. Qualifications

1. My name is Steven N. Wiggins. I am a Professor of Economics Emeritus at Texas A&M University. I retired from Texas A&M University in May 2021 where I had taught since 1979. In my time at Texas A&M, I served in chaired professorships, including serving as the George and Mary Jordan Professor of Economics and Public Policy from 1993 to 1999, and serving as the Rex B. Grey Professor of Economics at the Private Enterprise Research Center at Texas A&M from 1986 to 1989. I also served as a Visiting Lecturer at the University of the Saarlands and the Johann Wolfgang Goethe University, both in Germany.

2. I received my Ph.D. in Economics from MIT in 1979. My primary field in economics is Industrial Organization. In addition, I have areas of concentration in financial economics and econometrics—the latter being the branch of economics concerned with statistics and the measurement of economic data. My curriculum vitae appears as Appendix A to this report.

3. Industrial Organization is the field of economics that involves competitive conditions in markets, antitrust, research and development, intellectual property, advertising and brand names, distribution, contracting, and the theory of the firm. As a field, Industrial Organization focuses on developing general economic models of firm behavior. Specifically, Industrial Organization economists develop theoretical and empirical methods designed to address issues regarding market power, competition, price and non-price strategies (such as advertising and promotion) to compete in markets, profitability, and the valuation of firms and property. The methods developed apply both generally and to particular industries.

4. During my time at Texas A&M, I taught Ph.D. and undergraduate level classes in Industrial Organization and Economic Theory. These courses dealt with a wide variety of economic models, bargaining models, analytical methods, and industries. These courses also dealt specifically with antitrust, valuation, the economics of advertising and promotion, and intellectual property in addition to the broader topics discussed above. I also taught graduate and undergraduate courses in microeconomic theory.

5. I have authored or co-authored more than 35 scholarly articles on a variety of economic issues. These articles have been published in leading journals in economics and law, including the American Economic Review, the Journal of Political Economy, the Review of Economics and Statistics, the Journal of Legal Studies, and others. A list of these publications is included in my curriculum vitae, which can be found in Appendix A.

6. I have undertaken a variety of academic studies including both theoretical and empirical work applied to numerous industries designed to address a wide range of issues. That work has addressed topics in contracting, the theory of the firm, bargaining, competition, pricing, intellectual property, regulation, research and development, and patents. I have directly applied the models developed in my studies to a wide variety of industries. I have also developed and published models that apply economy-wide.

7. My academic research has been supported by the federal government, including grants through the National Science Foundation, the Office of Technology Assessment, and the Federal Trade Commission. It has also been supported by the governments of the State of Texas and the Federal Republic of Germany, as well as numerous private organizations and firms.

8. I have lectured nationally and internationally regarding my research. These research presentations include seminars at prestigious public and private U.S. universities, such as Harvard, MIT, Yale, Chicago, Stanford, UCLA, Michigan, Wisconsin, and Northwestern, and including the law schools of Yale, Columbia, Chicago, and Stanford. I have also lectured at professional meetings in the United States and abroad. I have provided long-term lecture series twice in Germany and once in Italy, dealing with the economics of contracts and firms.

9. I have also been asked to testify and have testified extensively in the United States, including in federal courts such as federal District Courts, the Court of Claims, and the Tax Court, as well as in state courts in Texas. My testimony has included a wide variety of analyses, including covering antitrust liability and damages related to monopolization, exclusionary conduct, group boycott, price-fixing, predatory pricing, and collusion. I have also testified regarding a broad range of economic damages including breach of contract and intellectual property. I have testified in matters involving a variety of industries. A list of the cases in which I have provided deposition or trial testimony in the last ten years is

included in my curriculum vitae, which can be found in Appendix A.

B. Assignment

10. I have been asked by counsel for Google LLC (hereafter, "Google") to analyze the civil penalties claimed by the plaintiff States for alleged violations of state deceptive trade practices acts (DTPAs), and to evaluate the opinions rendered by one of their expert witnesses, Mr. Jeffrey S. Andrien and certain opinions related to penalties offered by their expert witness Professor Weinberg. While my analyses assume, *arguendo*, that Google has been found to have committed the alleged violations, I am not expressing an opinion as to whether the evidence in the record would support such a conclusion.

11. I am being compensated at my standard billing rate of $1,200 per hour. This compensation is not dependent in any way on the opinions I express or the outcome of this matter. My work in this case has been supported by Charles River Associates ("CRA"), a consulting firm of which I am a Senior Consultant. The CRA professionals that assisted me in this matter worked under my direction and supervision. In addition to my hourly compensation, I also receive compensation from CRA based on billings by CRA's staff in this matter.

12. Appendix B to this report identifies the materials I have relied upon in forming my opinions. In reaching the opinions set forth in this report, I also relied on my general training in economics, and my teaching and research background and experience in Industrial Organization, economic theory, and antitrust economics.

13. My review and evaluation of case facts and issues is ongoing. I reserve the right to supplement or modify my opinions based on additional discovery materials, expert reports, pleadings, and other material that becomes available.

C. Summary of Opinions

14. Plaintiffs' expert, Mr. Jeffrey S. Andrien, opines that civil penalties for DTPA violations should "penalize[] Google for at least the benefits it gained associated with the alleged misconduct."[1] Purporting to apply that framework, Mr. Andrien concludes that it would be appropriate to impose DTPA civil penalties up to $21.81 billion on Google for alleged

[1] Expert Report of Mr. Jeffrey Andrien, June 7, 2024 ("Andrien Report") at ¶ 106.

deception[2] concerning Reserve Price Optimization, Dynamic Revenue Sharing, Project Bernanke, Alchemist, and the Network Bidding Agreement with Facebook.[3] Mr. Andrien calculates total DTPA civil penalties by multiplying (a) the number of transactions that he assumes to have been affected by the alleged deception by (b) a per-violation penalty that he deems appropriate.[4] This approach is flawed for numerous reasons.

15. Mr. Andrien's approach fails to follow his own framework. Instead, Mr. Andrien, at the apparent request of plaintiffs' counsel, assumes that all transactions "within the assumed period associated with each misconduct" were "affected."[5] Mr. Andrien makes no attempt to link these allegedly "affected" transactions to any gains to Google from the alleged deception. Mr. Andrien also proposes an arbitrary and inflated per-violation penalty that is ungrounded in either economics or his own framework. Mr. Andrien's only explanation for his proposed per-violation penalty is "information available to me as of today" and "my education, training and experience."[6] See Section III.

16. Mr. Andrien makes numerous errors in calculating the number of transactions that correspond to the alleged DTPA violations. He erroneously counts worldwide rather than U.S. transactions; includes in-app transactions that he claims to have excluded; fails to exclude transactions pertaining to states that cannot recover penalties for business-to-business transactions; fails to use the available data about customer locations when allocating transaction counts to the plaintiff States; includes transactions occurring in time periods after the relevant programs had been publicly disclosed; and fails to account for state statutes of limitations. In addition, Mr. Andrien includes transactions for which the alleged deception did not impact whether the transaction cleared on AdX, the clearing

[2] Throughout this report, I use the term "deception" to refer to all Google conduct plaintiff States allege to be unfair, false, deceptive, misleading, abusive, unconscionable, or otherwise in violation of any of the plaintiff States' respective deceptive trade practices laws.

[3] See Andrien Report at ¶¶ 45, 52-53, 127-130, and Table 4.

[4] See Andrien Report at ¶¶ 127-130.

[5] Andrien Report at ¶ 98 ("I have assumed that Google's misconduct indirectly affected all Open Auctions within the assumed period associated with each misconduct"); *id.* at ¶ 98 footnote 267 ("I have been asked to assume based on Professor Weinberg's report that all auctions during the period in which RPO, DRSv1, DRSv2, and Bernanke misconducts were active were affected by the claimed misconduct, whether they were directly targeted by the misconduct or not.").

[6] Andrien Report at ¶ 128 ("Based on the information available to me as of today, the analysis presented in this report, as well as my education, training, and experience, I conclude that it would be reasonable and appropriate for the trier of fact to assess a penalty in the range of [redacted] for each violation.").

price, or the revenue share charged by Google. Correcting these basic errors reduces Mr. Andrien's transaction count by 98 percent.[7] See Section IV.

17. Mr. Andrien's proposed per-violation penalties vastly overstate the incremental benefits to Google from the alleged deception. The lower and upper ranges of per-violation penalties proposed by Mr. Andrien are roughly [redacted] and [redacted] times Google's profit on affected transactions.[8] Mr. Andrien also fails to account for profits that Google would have earned regardless of any alleged deception. See Section V.

18. Correcting all of the foregoing errors would reduce the upper end of Mr. Andrien's DTPA civil penalty estimate from $21.81 billion to $44.9 million.[9] Even that corrected figure remains inflated—likely substantially so—because it wrongly assumes that Google would have made zero profit on affected transactions absent the alleged deception. See Section VI.

19. Mr. Andrien does not attempt to assess directly how much Google benefited from the alleged deception. I do so in Section VII, where I assume Google committed *all* of the violations described by Mr. Andrien. My analysis is grounded in the extensive evidence presented in Section II regarding how advertisers, publishers, and their intermediaries make decisions primarily by monitoring return metrics, performing tests, and learning and adapting, rather than by monitoring public announcements regarding optimization features. I conclude that none of the alleged deception in this case generated incremental profits for Google, and thus that the appropriate DTPA civil penalty based on Mr. Andrien's framework is zero. Nevertheless, I also perform an analysis adopting plaintiffs' experts' (incorrect) theories regarding advertiser and publisher behavior and estimate that applying Mr. Andrien's framework would result in $21.7 million in civil penalties rather than his vastly inflated amount.[10]

20. Mr. Andrien's other opinions are just as flawed as his penalties calculations. Mr. Andrien asserts that Google benefited indirectly from the alleged deception, but such effects are implausible and unsubstantiated. Mr. Andrien also incorrectly asserts that Google's

[7] See Table 1.
[8] See Table 2.
[9] See Table C3.
[10] See Table D5.

exceptional overall financial performance is a relevant factor for assessing penalties, notwithstanding the inconsistency with his own framework for assessing penalties and basic economic principles. Mr. Andrien further asserts that Google has a "history of violations" that justifies large penalties, but none of his examples involved allegations similar to the alleged deception asserted in this case. See Section VIII.

II. Background

A. Overview of Display Advertising

21. Display ads are defined as a "[v]isual digital advertising format which uses designs such as animation, images, text, and video to attract consumers' attention."[11] Web and app publishers monetize their online properties by selling display ad "inventory," which consists of blocks of space adjacent to other content on sites and apps that can be filled with display ads.[12]

22. Some ads permit or encourage "clicks" or actions. When a user elects to click on an ad, he or she is directed to another website where the user can learn more, or take an action, such as purchasing a product or downloading content. This latter class of actions is often referred to as "conversions," which can take many forms.[13]

23. In the early days of online display advertising in the 1990s, advertisers generally negotiated for ad placement directly with publishers in bulk.[14] As online advertising grew and evolved, ad tech firms developed tools that made it possible for publishers to sell advertising inventory impression-by-impression through auctions that occur when an

[11] "Glossary," *eMarketer*, available at https://totalaccess.emarketer.com/thesaurus.aspx (last accessed July 29, 2024).

[12] "Inventory basics: What is inventory?," *Google*, available at https://support.google.com/admanager/answer/10064557 (last accessed July 25, 2024).

[13] "Conversion Tracking: Definition," *Google*, available at https://support.google.com/google-ads/answer/6308 (last accessed July 25, 2024).

[14] "The History of Digital Advertising Technology," *Clearcode*, available at https://adtechbook.clearcode.cc/history-advertising-technology/ (last accessed July 25, 2024) ("It was during the early 1990s when many companies, organizations, and Internet enthusiasts started creating the first public websites. Advertisers soon spotted the potential that this new world had to offer and began testing uncharted waters. The year 1994 saw the first recorded example of online display advertising in the form of a banner ad, which appeared on a website called HotWired (now wired.com)…. In the early days of online display advertising, the exchange between an advertiser and a publisher was a direct sales process and resembled the way media had always been bought and sold.").

advertising opportunity arises as a user visits a website or uses an app.[15] An *impression* occurs when a user is shown a display ad, irrespective of whether the user elects to "click through" to the advertiser's content, online store, or other online resource.[16]

24. The process of placing an online display ad in front of a user occurs faster than the blink of an eye.[17] A primary purpose of these rapid transactions is to enable the placement of ads that target consumers precisely based on their interests and characteristics. More specifically, the goal of such targeting is to match particular ads to users whose "specific traits, interests, and preferences" are more likely to result in outcomes sought by the advertiser.[18] This targeting creates value by enabling advertisers to reach a more specific audience than is possible with more traditional methods such as newspapers and television. The ability to reach specific audiences also benefits publishers by increasing the value of their ad inventory.[19] And users benefit by viewing ads more aligned with their interests.[20]

25. Ad tech platforms accomplish targeting by facilitating the "matching" of publishers (who seek to monetize the ad inventory on their websites and apps) and advertisers (who purchase ad inventory to reach their target audiences).

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[15] "The History of Digital Advertising Technology," *Clearcode*, available at https://adtechbook.clearcode.cc/history-advertising-technology/ (last accessed July 25, 2024); "Real-time bidding (RTB)," *ClearCode*, available at https://clearcode.cc/glossary/real-time-bidding-rtb/ (last accessed July 25, 2024).

[16] Sharma, Deepak, "The Ultimate Guide to Ad Impressions: Maximizing Your Impact," *AdPushUp*, March 31, 2024, available at https://www.adpushup.com/blog/ad-impressions/ (last accessed July 25, 2024) ("An ad impression is a fundamental metric in online advertising. It occurs when an advertisement is successfully displayed to a user on a website, mobile app, or any digital platform. It signifies that the ad has been visually presented, regardless of whether the user interacts with it or not.").

[17] See Zawadziński, Maciej and Mike Sweeney, "How Does Real-Time Bidding (RTB) Work?," *Clearcode*, April 16, 2024, available at https://clearcode.cc/blog/real-time-bidding/ (last accessed July 25, 2024) ("One of the most remarkable facts about RTB is the speed of the auctions in the ad exchanges – each transaction takes about 100 milliseconds (a 10th of a second). To put that into perspective, it takes about 300 milliseconds to blink." (internal emphasis omitted)).

[18] "What is Targeted Advertising?," *GCF Global*, available at https://edu.gcfglobal.org/en/thenow/what-is-targeted-advertising/1/ (last accessed July 25, 2024).

[19] Wu, Susan, "How Publishers And Advertisers Can Activate Sell-Side Targeting," *PubMatic*, February 8, 2023, available at https://pubmatic.com/blog/how-publishers-and-advertisers-can-activate-sell-side-targeting/ (last accessed July 25, 2024) ("Sell-side targeting enables publishers to monetize even more inventory[.]").

[20] "Poll: Americans Want Free Internet Content, Value Interest-Based Advertising," *American Association of Advertising Agencies*, April 18, 2023, available at https://www.aaaa.org/pollamericanswantfreeinternetcontentvalueinterest-basedadvertising/ (last accessed July 25, 2024) ("Nearly 70 percent of respondents indicated that they'd like at least some ads tailored directly to their interests[.]").

26. Facilitating such matches is highly valuable economically.[21] Each day, this matching process leads to transactions for billions of impressions. For example, Google's ad exchange transacted about [redacted] Open Auction impressions per day in the United States during 2022.[22]

27. There are a host of intermediaries that facilitate this complex process of placing an impression in front of the user. Collectively, these intermediaries constitute what is called the "Ad Tech Stack." Each intermediary plays a role in helping publishers optimize sales of their ad inventory and in helping advertisers learn and optimize their ad spend, enhancing the overall efficiency and value of the matching process. Intermediaries in the Ad Tech Stack include (among others) publisher ad servers, ad buying tools, and ad exchanges. In addition, as discussed in Section II.B.2, advertising agencies help advertisers monitor performance, learn, and adjust strategies and budgets accordingly.

28. Publisher ad servers are "responsible for storing, managing, and serving ads on a publisher's website based on targeting attributes," via both real time bids and direct deals.[23] Google used to offer publisher ad server functionality through DoubleClick For Publishers ("DFP"), and that functionality has now been incorporated into Google Ad Manager ("GAM").[24] Other publisher ad servers include, for example, Equativ's Smart AdServer,[25] Microsoft's Xandr (formerly AppNexus),[26] and Comcast's Freewheel.[27]

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[21] According to a December 2023 forecast, US programmatic digital display ad spend will total $157.35 billion in 2024. See "Guide to programmatic advertising: Market, types, and buying process explained," *eMarketer*, February 14, 2024, available at https://www.emarketer.com/insights/programmatic-digital-display-ad-spending/ (last accessed July 25, 2024).

[22] Calculation based on Google's AdX Data (for data sources and calculations, see workpaper "Daily AdX Transactions in 2022.xlsx").

[23] Zaiceva, Alise, "What is an Ad Server? | A Complete Guide for Publishers," *Setupad Blog*, September 1, 2023, available at https://setupad.com/blog/ad-server/ (last accessed July 25, 2024); Zawadziński, Maciej and Mike Sweeney, "What is an Ad Server and How Does It Work?," *Clearcode*, March 7, 2018, available at https://clearcode.cc/blog/what-is-an-ad-server/ (last accessed July 25, 2024).

[24] In 2018, GAM combined the features of two former services, DFP (offering publisher ad server services) and AdX (offering ad exchange services). See GOOG-AT-MDL-C-000015714 at -714-720.

[25] Nelson, Marisa, "Smart AdServer Rebrands as Equativ," *Equativ*, June 8, 2022, available at https://equativ.com/blog/press-release/smart-adserver-rebrands-as-equativ/ (last accessed July 25, 2024).

[26] Bagatsky, Eugene, "Best Ad Servers for Publishers (in 2022)," *Snigel*, January 20, 2022, available at https://snigel.com/blog/best-ad-servers-for-publishers (last accessed July 25, 2024).

[27] "Comcast buys advertising startup Freewheel for $360 million," *Reuters*, March 6, 2014, available at https://www.reuters.com/article/idUSL1N0M31GL/ (last accessed July 25, 2024); "For Sellers: SupplySuite," *FreeWheel*, available at https://www.freewheel.com/supplysuite (last accessed July 25, 2024).

Prices for these publisher ad servers typically take the form of fixed per-transaction fees [redacted].[28]

29. Intermediaries on the buying side include demand side platforms ("DSPs") and other ad buying tools.[29] Google operates two popular ad buying tools: Google Ads and DV360. Other ad buying tools include, e.g., The Trade Desk,[30] Adobe,[31] and Amazon DSP.[32]

30. Ad buying tools serve as an interface between advertisers and the remainder of the Ad Tech Stack. Advertisers that wish to place ads programmatically provide their ad buying tools with advertising budgets, together with other campaign constraints and objectives.[33] Besides budgets, common advertiser constraints include the maximum amount to bid,[34] the rate at which the budget is spent,[35] the maximum amount to spend per viewable impression,[36] and the average cost over multiple conversions.[37] Advertisers also can

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[28] [redacted] see also "Vocento Enters Partnership with Smart," *ExchangeWire*, January 5, 2022, available at https://www.exchangewire.com/blog/2022/01/05/vocento-enters-partnership-with-smart/ (last accessed July 25, 2024) ("Equativ is the new single name for Smart Adserver[.]").

[29] I understand that plaintiffs allege that there are distinct antitrust markets for (a) buying tools for small advertisers; and (b) buying tools for large advertisers. See Fourth Amended Complaint, *State of Texas*, *et al. v. Google LLC*, 4:20-cv-00957-SDJ (E.D. Tex. May 5, 2023) ("FAC") ¶¶ 163-186, 196-214. My analysis does not depend on such distinctions, and I use the terms "ad buying tools" and "DSPs" interchangeably to refer to all buy-side intermediaries.

[30] "Demand Side Platform: Achieve your marketing goals," *The Trade Desk*, available at https://www.thetradedesk.com/us/our-platform/dsp-demand-side-platform (last accessed July 25, 2024).

[31] "One demand-side platform to rule them all," *Adobe*, available at https://business.adobe.com/products/advertising/demand-side-platform.html (last accessed July 25, 2024).

[32] "Amazon DSP: Your brand in new places," *Amazon*, available at https://advertising.amazon.com/solutions/products/amazon-dsp (last accessed July 25, 2024).

[33] 30(b)(1) Deposition of [redacted] (Google), April 25, 2024 ("30(b)(1) [redacted] (Google) Deposition"), at 256:11-12 ("And constraints, budget is one example, but advertisers might give us more constraints as well.").

[34] "Choose a bid amount that works for you," *Google*, available at https://support.google.com/google-ads/answer/2471184?hl=en (last accessed July 25, 2024).

[35] "Set budgets and control your pacing," *Google*, available at https://support.google.com/displayvideo/answer/3114676?hl=en (last accessed July 25, 2024).

[36] "About bidding on impressions," *Google*, available at https://support.google.com/google-ads/answer/2630842?hl=en (last accessed July 25, 2024) ("With vCPM bidding, you bid for your ad based on how often it appears in a viewable position. … You set the max amount you want to pay for viewable ads, whether they're clicked or not.").

[37] "About Target CPA bidding," *Google*, available at https://support.google.com/google-ads/answer/6268632?hl=en (last accessed July 25, 2024) ("Some conversions may cost more than your target and some may cost less, but altogether, Google Ads will try to keep your cost per conversion equal to the target CPA you set.").

impose common targeting constraints, such as by website, geography, devices, and demographics.[38] Ad buying tools operate within the constraints and objectives provided by advertisers and their advertising agencies.

31. Advertisers can also choose the basis on which they will pay for display advertisements. It is useful to divide these alternatives into payments for impressions, where prices are denominated on a cost-per-mille (i.e., per-thousand) impressions (CPM) basis, and payments that occur on a cost-per-click (CPC) or cost-per-action (CPA) basis.[39] When advertisers pay on a CPM basis, the ad buying tool prepares bids consistent with advertiser budgets, constraints, objectives, and willingness to pay, and then collects a buy-side fee from the advertiser.[40]

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[38] [redacted]

[39] 30(b)(6) Deposition of [redacted] at 92:9-12 [redacted] Many ad buying tools offer CPC pricing. See, for example, Google Ads ("Cost-per-click (CPC): Definition," *Google*, available at https://support.google.com/google-ads/answer/116495?hl=en (last accessed July 25, 2024)), DV360 (During the period covered by the DV360 data, about less than 1% of the impressions were paid on a CPC basis. For sources and calculations, see workpaper "DV360 Impressions by Advertiser Payment Model.xlsx"); TheTradeDesk ("Campaign," *The Trade Desk*, available at https://partner.thetradedesk.com/v3/portal/api/doc/Campaign (last accessed July 25, 2024) (CPC pricing description states "the amount the advertiser pays every time an ad is clicked. If your primary engagement metric is clicks, you may want to choose CPC as your goal")); Microsoft's Xandr ("Microsoft Invest – Set up line item optimization," *Microsoft Xandr Platform*, February 19, 2024, available at https://learn.microsoft.com/en-us/xandr/invest/set-up-line-item-optimization (last accessed July 25, 2024) (under "Set a goal type," the website states "Select this type if your advertiser wants to track and report against a cost per click goal. Enter the CPC amount in the text field.")); and Amazon Ads ("CPC (Cost per Click) explained," *Amazon*, available at https://advertising.amazon.com/library/guides/cost-per-click (last accessed July 25, 2024) (Under "What is CPC?," the website states "CPC is the cost per click that an ad receives")).

[40] Various ad buying tools collect fees using technically different, but economically similar, mechanisms. For example, some deduct fees from bids and others add a charge to the bid amount. See "Display & Video 360 Help: Total Media Cost," *Google*, available at https://support.google.com/displayvideo/answer/3007271?hl=en (last accessed July 25, 2024) (explaining that DV360 adds its platform fees and any other third-party fees (such as data fees, ad server fees, ad serving verification fees) to its price of buying impressions (media cost)); "Microsoft Monetize – Charges for buyers," *Microsoft Xandr Platform*, February 26, 2024, available at https://learn.microsoft.com/en-us/xandr/monetize/charges-for-buyers (last accessed July 25, 2024) (explaining that

32. When advertisers pay on a CPC or CPA basis, the advertiser similarly sets up budgets, constraints and objectives, commonly including a maximum CPC or maximum CPA that it is willing to pay.[41] The ad buying tool then incorporates these restrictions, decides on which impressions to bid, and uses its own algorithms to determine how much to bid for those impressions on a CPM basis.[42]

33. The vast majority of Google Ads advertisers choose to pay for impressions on a CPC or CPA basis. In each year from 2012 to 2023, more than [redacted] percent of display impressions purchased by advertisers using Google Ads were paid for on a CPC or CPA basis.[43]

34. When advertisers choose to pay on a CPC or CPA basis, the ad buying tool buys many impressions and receives no payment from the advertiser for most of them.[44] But when a click or action does occur, the ad buying tool receives a payment that, in general, exceeds

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Xandr DSP offers a choice on how its platform fee is charged; the platform fee can either be charged as a reduction in its bid amount or as a separate fee added to its price of buying impressions).

[41] Strategies tailored to secure such other actions can be accomplished by what Google terms "Target CPA bidding," where "CPA" stands for cost per action. Google explains that "[t]arget CPA bidding is an automated bid strategy that sets bids for you to get as many conversions or customer actions as possible. When you select the Target CPA (cost-per-action) bid strategy, you set your desired average cost per conversion. Google Ads uses your Target CPA to set a bid based on the likelihood of the ad to convert." "About Target CPA bidding," *Google*, available at https://support.google.com/google-ads/answer/6268632?hl=en (last accessed July 25, 2024); see also 30(b)(6) Deposition of [redacted] (Google), April 26, 2024 ("30(b)(6) [redacted] (Google) Deposition"), at 21:10-22:1 ("There are different kinds of GDN advertisers. There are advertisers who specify that, for example, spend my budget, give me as many conversions as possible, but charge me a fixed cost per conversion. So in those cases, for example, they would just be charged that fixed cost per conversion that they wanted to be charged. There are such other categories of advertisers who may specify, I want to be charged a certain cost per conversion; and they would be charged a certain cost per conversion. And then there are some advertisers who do not express that – objectives in that way. Rather, they might specify a maximum bid to win that they're willing to pay. And in those cases, we would charge them the as if it was a second-price auction.").

[42] See GOOG-TEX-00993980 at -981, -991 ("The GDN auction decides which ads we serve to users for each query. As with any auction, we can design the auction to maximize the welfare of different participants. The GDN auction is designed to maximize the welfare of all advertisers, and emphasize fairness…. [redacted].

[43] Calculation based on Google's AdX Data (for data sources and calculations, see workpaper "Google Ads Impressions by Advertiser Payment Model.xlsx").

[44] The vast majority of display impressions do not lead to a click. Click-through rate (i.e., the ratio of number of clicks and number of impressions) for display ads is typically below 1%. See Raehsler, Lisa, "What is a Good CTR? Is Your Click-Through Rate Good Enough?," *Agency Analytics*, May 19, 2023, available at https://agencyanalytics.com/blog/average-click-through-rate (last accessed July 25, 2024). According to Google's AdX data, Google Ads on average purchased [redacted] impressions for each click that it purchased in open auctions in the U.S. during 2016-2023 (for data sources and calculations, see workpaper "Google Ads Impressions Purchased per Click.xlsx").

the cost of the many impressions purchased to obtain that one click or action. As a result, the buying tool's margin (or revenue share) becomes an amalgamation associated with outgoing payments made for many impressions, but only a single incoming payment made for the click or action. On average, Google Ads has sought to retain 14 or 15 percent of the payments made by advertisers, with the remainder spent on payments for impressions won by the advertiser.[45]

35. To translate an advertiser's willingness-to-pay for a click (known as maxCPC) into an amount the ad buying tool is willing to bid (typically expressed as an eCPM), the ad buying tool must assess the likelihood that each impression will lead to a click, which is called the predicted click-through-rate or pCTR.[46] This pCTR and other factors are used by the ad buying tool to determine how much the tool will bid into the auction on a CPM basis.[47]

36. Ad buying tools, including Google Ads, have a strong incentive to provide clicks at low cost.[48] When the ad buying tool can supply clicks at a lower cost, the advertiser is better able to meet its campaign goals, and it will willingly buy more such clicks until its budget is fully utilized. And when the CPCs that advertisers pay are low, advertisers enjoy higher returns.[49] Those returns attract more spending and still larger budgets to the ad buying

[45] See GOOG-AT-MDL-C-000009970 at -973 ("GDN maintains a desired margin of 14% for 'fair' payout to pub[.] Note that we can not achieve 14% on every query because we pay per impression and receive revenue per click. Aim for 14% margin in expectation (over a set of queries)"); 30(b)(1) [redacted] (Google) Deposition at 43:1-6 ("at some point", Google Ads' target margin was changed to 15% and that, today, "[i]n aggregate, Google's margin on buying on AdX continues to be 15 percent.").

[46] GOOG-TEX-00993980 at -983 (presenting the relationship between the "maximum estimated/expected cost per mille (MaxEcpm) to maxCPC and pCTR in Google Ads). The click through rate (CTR, i.e., the ratio of number of clicks and number of impressions) for display ads is typically below 1%. Raehsler, Lisa, "What is a Good CTR?: Is Your Click-Through Rate Good Enough?," *Agency Analytics*, May 19, 2023, available at https://agencyanalytics.com/blog/average-click-through-rate (last accessed July 25, 2024).

[47] [redacted]

[48] Providing clicks at the lowest possible cost includes achieving low CPMs, but also includes allocating money to impressions most likely to generate a click for a given advertiser. See, e.g., 30(b)(1) [redacted] (Google) Deposition at 306:1-6 ("[A] negative profit refers to losing money and it's pretty common because of the nature of the AdWords [now known as Google Ads] model where advertisers only pay when there's a click, but we have to pay the publisher on every impression.").

[49] 30(b)(1) [redacted] (Google) Deposition at 69:3-5 ("So it's critical for us to give good performance if you want to continue to attract advertiser budgets."); *id.* at 82:23-83:1 ("[T]he goal is to build a better product for AdWords advertisers; that we're hoping they would continue to use it and bring in more budgets to AdWords."); *id.* at 27:23-25

tool.[50] As described more fully below, advertisers generally focus on the returns generated by their campaigns, and they compare the performance of various ad buying tools in helping them achieve their goals.[51]

37. A portion of the advertiser's budget may remain unspent if the ad buying tool is unable to find sufficient clicks at prices below the advertiser's maxCPC. In the earliest period for which data is available, which appears to be [redacted], these "budget unconstrained advertisers" [redacted]. As described below, Google Ads invented a bidding strategy–known as Bernanke–to provide more clicks (without exceeding the maxCPC), thus benefiting both Google Ads and its advertiser customers. Google Ads benefited by receiving a buy-side margin on a larger portion of advertisers' budgets, and the advertisers benefited because they were able to acquire more clicks at a price at or below their maximum CPCs.[53]

38. Ad buying tools bid into ad exchanges, sometimes called supply-side platforms or "SSPs."[54] Ad exchanges conduct online auctions for inventory and collect payments from

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("Google buy-side is trying to buy ad inventory the best possible way for advertisers to maximize advertiser value.") *id.* at 127:16-22 ("advertisers are giving us a budget and trusting us to deliver the best performance that we can deliver. And doing so is critical for AdWords to be a successful product. And hence overpaying and providing suboptimal value for advertisers is not in AdWords' interest as a buy-side product.").

[50] 30(b)(1) [redacted] (Google) Deposition at 60:22-25 and 62:4-9 ("My hope is that by launching quality improvements such as Bernanke and other improvements that we made over the years, more advertisers have used AdWords. …Advertisers' payments to Google, like I said, you know, it depends on performance and my hope is by improved performance, advertisers also use the product more and bring in more … budgets.").

[51] See, e.g., [redacted]

[52] GOOG-DOJ-13625417 at -419 (indicating that "[redacted]% of GDN advertisers are budget unconstrained."). This presentation indicates that the "current status" of the work to which it refers was as of the [redacted] See *id.* at -426. Other slides in this presentation likewise refer to information from [redacted]. See, e.g., *id.* at -433.

[53] Profit-maximizing advertisers will set their maximum CPC so that it is less than or equal to the benefit the advertiser expects to receive from the click. As a result, advertisers are made better off whenever Google Ads can provide clicks below their maximum CPCs. This is in accord with the fundamental economic principle that profit maximizing firms act to equate the marginal revenue from an action equal to the marginal cost of that action. See, e.g., Mankiw N., Gregory, Ronald D. Kneebone, and Kenneth J. McKenzie, *Principles of Microeconomics*, 10th Canadian ed. 2017, at 307 ("[There are] three general rules for profit maximization: 1. If marginal revenue is greater than marginal cost, the firm should increase its output. 2. If marginal cost is greater than marginal revenue, the firm should decrease its output. 3. At the profit-maximizing level of output, marginal revenue and marginal cost are exactly equal. These rules are the key to rational decision making by any profit-maximizing firm. They apply not only to competitive firms but, as we will see in the next few chapters, to other types of firms as well.").

[54] See, e.g., "What is a Supply-Side Platform (SSP)? Here's everything you need to know," *Amazon Ads*, available at

winning bidders, and then deduct the ad exchange's revenue share before remitting the balance to publishers. Transactions on ad exchanges are commonly carried out using first-price or second-price auctions.[55] Google's ad exchange, AdX, has been integrated into Google Ad Manager (GAM).[56] There are many other ad exchanges, including Xandr, OpenX, Magnite, Pubmatic, and Index Exchange.[57]

B. Learning-By-Doing in the Ad Tech Industry

39. A proper economic assessment of the issues in this case requires understanding the

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https://advertising.amazon.com/library/guides/supply-side-platform (last accessed July 25, 2024); Wlosik, Michal and Maciej Zawadziński, "What Is a Supply-Side Platform (SSP) and How Does It Work?," *Clearcode*, January 31, 2024, available at https://clearcode.cc/blog/what-is-supply-side-platform/ (last accessed July 25, 2024).

[55] For a discussion of the economics of first- and second-price auctions, see, for example, Villas-Boas, Sofia B., "An Introduction to Auctions," *Journal of Industrial Organization Education*, Vol. 1, Issue 1, Article 5, 2006, explaining that in first price auctions, the bidder who submits the highest bid wins the auction and is charged its bid. Economic theory teaches that, in first-price auctions, advertisers have an incentive to reduce (or "shade") their bids below their willingness to pay for the impression. The basic intuition is that, if the advertiser bids its willingness to pay and wins, it obtains no "surplus" from the auction (where advertiser surplus is the difference between the maximum amount that the advertiser would be willing to pay for an impression and what it actually pays for the impression). In such instances, the winning bidder is no better off than had it not offered a bid in the first instance. But if the advertiser wins when bidding below its willingness to pay, then it achieves a positive surplus. According to auction theory, the optimal amount of shading is the result of a trade-off between (i) a lower likelihood of winning from more shading, and (ii) a higher surplus from more shading when the advertiser does win the auction.

In second price auctions, on the other hand, the bidder who submits the highest bid wins the auction and is charged the second-highest bid or, when it is higher, the reserve or floor price for the auction. Only bids above the "floor" price can win an auction. When all bids are below the floor price for an online display ad auction, the auction is said to have not "cleared," meaning that no bidder in that auction wins the impression. In a static (i.e., non-repeated) second-price auction, advertisers have an incentive to bid their willingness to pay for the impression that is being auctioned off. The basic intuition why advertisers would not bid less than their willingness to pay in a second-price auction is that doing so would reduce the advertiser's likelihood of winning the auction, but it would not lower the price it would pay if it wins the auction. This price depends on only the second highest bid (and not the winner's bid). If a bidder needs to increase its bid above its willingness to pay in order to win an auction, then it will necessarily suffer a loss from winning the auction because it will end up paying more than its willingness to pay.

[56] See, e.g., Ramaswamy, Sridhar, "Introducing simpler brands and solutions for advertisers and publishers," *Google*, June 27, 2018, available at https://blog.google/technology/ads/new-advertising-brands/ (last accessed July 25, 2024); Marvin, Ginny, "Google is Retiring the AdWords & DoubleClick Brands in a Major Rebranding Aimed at Simplification," *Search Engine Land*, June 27, 2018, available at https://searchengineland.com/google-is-retiring-the-adwords-doubleclick-brands-in-a-major-rebranding-aimed-at-simplification-301073 (last accessed July 25, 2024) ("Google is also introducing some new solutions that further the push toward simplifying its advertising offerings.… DoubleClick for Publishers and DoubleClick Ad Exchange are integrated into a new unified platform called Google Ad Manager.").

[57] See Trevisani, Jonathan, "The Best Ad Exchanges for Publishers in 2024," *Playwire*, available at https://www.playwire.com/blog/best-ad-exchanges-for-publishers (last accessed July 25, 2024); "What is a Supply-Side Platform (SSP)? Here's everything you need to know," *Amazon Ads*, available at https://advertising.amazon.com/library/guides/supply-side-platform (last accessed July 25, 2024); "What Is a Supply-Side Platform (SSP) and How Does It Work?," *Clearcode*, available at https://clearcode.cc/blog/what-is-supply-side-platform/ (last accessed July 25, 2024).

behavior of advertisers and publishers. Such understanding in turn requires taking into account the information available to and provided by various market participants, and understanding how participants use this information to learn and to adjust their behavior. This approach is rooted in the substantial and well-regarded economic literature on learning, as well as the evidence in this case. That evidence shows that advertisers, ad buying tools, and advertising agencies generally learn how to optimize returns on ad purchases through careful experimentation and monitoring of their spending. Publishers also generally monitor returns and conduct experiments to identify strategies to optimize their revenue, such as through setting price floors.

40. Plaintiffs' theory unduly emphasizes the role of announcements about optimization features,[58] despite the evidence that advertisers typically do not pay attention to them.[59] Plaintiffs' theory further fails to take into account the evidence that advertisers and publishers learn through experimentation and rely on numerous specialized intermediaries

[58] FAC ¶¶ 328 ("Google … withheld critical information that the parties could have used to make an informed decision about the program"), 343 ("Google did not disclose … and misled publishers and advertisers as to how the program worked."), and 538 ("[A]dvertiser's bid data was used against them to increase the floor price in an auction and each time an advertiser paid more for an impression they otherwise would have had they not been misled by Google's misstatements or had RPO been properly disclosed[.]").See also Expert Report of Parag Pathak, June 7, 2024, ("Pathak Report") at ¶¶ 197 ("Had publishers and advertisers known about these programs, they would have the opportunity to adjust their behavior"), 268 ("[I]f publisher and advertisers knew how the deception changed the rules of the auction, they could change their behavior. If publishers and advertisers knew the rules of the auction, they may choose to set floors or bids in a way where another exchange would win over AdX."); Expert Report of Joshua Gans, June 7, 2024 ("Gans Report") at ¶ 15 ("Had Google's customers known about Google's manipulations of the auction rules that customers were accustomed to, customers would have considered products from Google's competitors."); Expert Report of Matthew Weinberg, June 7, 2024 ("Weinberg Report") at ¶ 250 ("[A]ll publishers likely would have changed their behavior if they knew about Projects Bernanke and Global Bernanke by raising their reserve prices.").

[59] [redacted]

to help them implement optimal strategies.

41. In Section II.B.1, I discuss the economic literature on learning-by-doing. Section II.B.2 describes various features of the Ad Tech industry that facilitate advertiser learning, as well as the evidence regarding how advertisers generally learn and seek to maximize their returns. In Section II.B.3, I discuss the evidence of similar behavior by publishers.

1. Learning-by-Doing Literature

42. Economists have long recognized learning-by-doing as an important phenomenon, beginning at least as early as the work of Nobel laureate Kenneth Arrow.[60] Subsequent work has applied learning-by-doing to various industries, demonstrating how learning can help decision-makers optimize in complex environments.[61] For example, there is ample research applying learning-by-doing in industries including agriculture,[62] aircraft manufacturing,[63] shipbuilding,[64] power plant design,[65] oil production,[66] and electricity auctions.[67]

43. Recent empirical work has highlighted the importance of experimentation in facilitating

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[60] See, e.g., Arrow, Kenneth J., "The Economic Implications of Learning by Doing," *The Review of Economic Studies*, Vol. 29, No. 3, 1962, pp. 155-173; Fudenberg, Drew and David K. Levine, "Learning and Equilibrium," *Annual Review of Economics*, Vol. 1, No. 1, 2009, pp. 385–419; Doraszelski, Ulrich, Gregory Lewis, and Ariel Pakes, "Just Starting Out: Learning and Equilibrium in a New Market," *American Economic Review*, Vol. 108, No. 3, 2018, pp. 565-615.

[61] See e.g., List, John A, "Does Market Experience Eliminate Market Anomalies?," *Quarterly Journal of Economics*, Vol. 118, No. 1, 2003, pp. 41-71; Goke, Shumpei, Gabriel Y. Weintraub, Ralph Mastromonaco, and Sam Seljan, "Bidders' Responses to Auction Format Change in Internet Display Advertising Auctions," *Working Paper*, January 2022 ("Goke, et al. (2022)"); Argote, Linda, Sara L. Beckman, and Dennis Epple, "The Persistence and Transfer of Learning in Industrial Settings," *Management Science*, Vol. 36, No. 2, 1990, pp. 140-154.

[62] Foster, Andrew D. and Mark R. Rosenzweig, "Learning by Doing and Learning from Others: Human Capital and Technical Change in Agriculture," *Journal of Political Economy*, Vol. 103, No. 6, 1995, pp. 1176-1209.

[63] Bernkard, Lanier C., "Learning and Forgetting: The Dynamics of Aircraft Production," *American Economic Review*, Vol. 90, No. 4, 2000, pp. 1034-1054. Research on learning-by-doing in aircraft manufacturing dates back to 1950. See Alchian, Armen A., "Reliability of Progress Curves in Airframe Production," Working Paper, *RAND Corporation*, 1950.

[64] Thompson, Peter, "How Much Did the Liberty Shipbuilders Forget?" *Management Science*, Vol. 53, No. 6, 2007, pp. 908-918.

[65] McCabe, Mark J., "Principals, Agents, and the Learning Curve: The Case of Steam-Electric Power Plant Design and Construction," *The Journal of Industrial Economics*, Vol. 44, No. 4, 1996, pp. 357-375.

[66] Kellog, Ryan, "Learning by Drilling: Interfirm Learning and Relationship Persistence in the Texas Oilpatch," *The Quarterly Journal of Economics*, Vol. 126, No. 4, 2011, pp. 1961-2004.

[67] Hortaçsu, Ali, Fernando Luco, Steven L., Puller, and Dongni Zhu, "Does strategic ability affect efficiency? Evidence from electricity markets," *American Economic Review*, Vol. 109, No. 12, 2019, pp. 4302-4342.

optimal decision-making.[68] The extensive nature of this literature and its importance are such that the topic warrants an entire chapter in the highly prestigious Handbooks in Economics series.[69]

44. This academic literature has been applied to study learning in the types of Ad Tech auctions at issue in this case. For example, a recent paper studied bidding behavior during the interval of time when Xandr (formerly known as AppNexus) switched its display advertising auction from a second-price to a first-price format.[70] The paper found that bidders (which were typically buy-side intermediaries such as DSPs) did not adjust their bids immediately; they learned over time how to adjust their bids in response to the format change. In particular, the authors found that "bidders learn over time how to better shade their bids using a combination of first-hand experience and industry-wide learning."[71] This pattern indicates that bidders experiment and learn, a form of learning-by-doing.[72]

2. Industry Characteristics and Advertiser Learning

45. Several features of the Ad Tech industry facilitate learning by advertisers, and thus have direct implications for evaluating the effect of Google's allegedly deceptive conduct.

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[68] See Luca, Michael and Max H. Bazerman, *The Power of Experiments: Decision Making in a Data-Driven World*, Cambridge: MIT Press, 2021, at vii-viii ("These days, companies like Google wouldn't dare make a major change in their platforms without first looking at experiments to understand how it would influence user behavior. From startups to international conglomerates to government agencies, organizations have a new tool to develop frameworks and test ideas, and to understand the impact of the products and services they are providing."); *id.* at 62 ("But perhaps no sector has embraced the experimental method more than the tech sector, where it is now a standard component of managerial decision making."). See also Wieland, Volker, "Learning by Doing and the Value of Optimal Experimentation," *Journal of Economic Dynamics and Control*, Vol. 24, 2000, pp. 501-534.

[69] See Thompson, Peter, "Chapter 10 – Learning by Doing," *Handbook of the Economics of Innovation*, Vol. 1, 2010, pp. 429-476.

[70] Goke, Shumpei, Gabriel Y. Weintraub, Ralph Mastromonaco, and Sam Seljan, "Bidders' Responses to Auction Format Change in Internet Display Advertising Auctions," *Working Paper*, January 2022 at 16 ("[T]hese bidders gradually learned to shade their bids to a level sustained by a rational strategy.").

[71] Goke, et al. (2022) at 4.

[72] Goke, et al. (2022) at 4 ("Our results suggest that existing auction theory can fail to correctly predict bidder behavior in the short run, which is an important fact for market designers. In the short run, bidders may have trouble bidding optimally and so it may appear that first-price auctions are driving price increases. As a result, it is easy for myopic market designers to draw a wrong conclusion that a format change increases prices. However, over the long run, as bidders adjust to market dynamics and learn to bid more effectively, the price increase dissipates."). Other research similarly concludes that learning by doing does a good job of explaining behavior in other markets. See, e.g., Doraszelski, Ulrich, Gregory Lewis, and Ariel Pakes, "Just starting out: Learning and equilibrium in a new market," *American Economic Review*, Vol. 108, No. 3, 2018, pp. 565-615; Hortaçsu, Ali, Fernando Luco, Steven L. Puller, and Dongni Zhu, "Does strategic ability affect efficiency? Evidence from electricity markets," *American Economic Review*, Vol. 109, No. 12, 2019, pp. 4302-42.

These features include: (a) advertisers' use of sophisticated ad buying tools that provide them with metrics on their advertising effectiveness (such as return on ad spend), which advertisers generally use to learn and optimize over time; (b) advertisers' use of advertising agencies that help them evaluate returns and allocate budgets across ad buying tools; (c) competitive pressures for advertising dollars—rooted in the monitoring of returns by advertisers and agencies, as well as the simultaneous use of multiple ad buying tools—that incentivize ad buying tools to continually learn and adapt; (d) the presence of continuous and meaningful feedback; and (e) the ease with which advertisers, advertising agencies, and ad buying tools can conduct experiments. The net impact of these factors is that advertisers need not, as a general matter, know all of the details about how Ad Tech optimizations and auctions operate. Instead, they (or their ad buying tools and ad agencies) continuously learn what strategies work best to maximize return on ad spend and adapt to implement those strategies.

a. Advertisers Rely on Sophisticated Ad Buying Tools

46. The *first* important feature of this industry is the presence of sophisticated ad buying tools (including non-Google services,[73] as well as Google's DV360 and Google Ads[74]) that

[73] Criteo explicitly points to the fact that since 2014 its bidding strategies have been honed over time based on learning from many transactions. Specifically, Criteo states that its Predictive Bidding feature "determines the right bid for every impression" because it is "Powered by 900TB of consumer data on the interactions between 700M shoppers and 4B products." See "What is Predictive Bidding," *Criteo*, available at https://www.criteo.com/technology/predictive-bidding (last accessed July 25, 2024); see also "What You Need to Know About First-Price Auctions and Criteo," *Criteo*, September 12, 2019, available at https://www.criteo.com/blog/first-price-auctions (last accessed July 25, 2024) ("Five years ago, Criteo started developing a smart bidding technology. This technology ensures a bid placed for any display opportunity offers the highest yield for clients and publishers. Criteo's state of the art bidder in non-pure second-price auctions is constantly improving. This accounts for bidding in both first-price and ever more complex environments.").Other DSPs, including Amazon and The Trade Desk, also offer optimization tools for advertisers. See "Sponsored Display custom bid optimizations," *Amazon Ads*, available at https://advertising.amazon.com/library/guides/sponsored-display-custom-bid-optimizations (last accessed July 25, 2024) ("When creating a campaign, you can optimize bidding for your specific needs by selecting one of the following optimizations: 'Optimize for Page Visits,' 'Optimize for conversions,' or 'Optimize for viewable impressions.'"); "Targeting and Optimization," *The Trade Desk*, available at https://partner.thetradedesk.com/v3/portal/api/doc/TargetingOptimizationOverview (last accessed July 25, 2024); "Optimization buying strategies," *Microsoft Xandr Platform*, available at https://learn.microsoft.com/en-us/xandr/monetize/optimization-buying-strategies (last accessed July 25, 2024).

[74] Similarly, Automated Bidding is a Google Ads service that "sets bids for your ads based on that ad's likelihood to result in a click or conversion that helps you achieve a specific goal for your business." "About Automated Bidding," *Google*, available at https://support.google.com/google-ads/answer/2979071?hl=en (last accessed July 25, 2024).

compete to help advertisers purchase impressions and track performance.[75] These ad buying tools greatly simplify advertiser decision-making because they choose the impressions on which to bid and prepare and submit bids into auctions.[76] This means that instead of focusing on auction dynamics, the impressions to bid on, and how much to bid, advertisers can simply assess the cost effectiveness of and returns generated by these ad buying tools.[77]

47. Advertisers can focus on performance in part because the ad buying tools provide them with ready, salient, and valuable metrics by which they can measure the effectiveness of ad campaigns.[78] These metrics include return on ad spend ("ROAS") or return on

[75] See GOOG-AT-MDL-004253447 at -461, -473, (highlighting the need for Google Ads' autobidding tool "to defend performance in competitive landscape" and the "need to differentiate" from "new low cost RTB services [i.e., real time bidding tools] … [which] provide smart RTB at a low price point (and may reach more inventory too). We need to differentiate: (i) prove value of our algorithms vs. basic rules; (ii) highlight value of network quality and spam controls.").

[76] See, e.g., GOOG-AT-MDL-004253447 (describing how "managing bids for all possible auctions is impossible and unnecessarily complex for advertisers. We should have an autobidding strategy for all advertiser's goals"); 30(b)(1) [redacted] (Google) Deposition at 260:10-16 ("[Value computation is] based on the objectives and constraints that advertisers set and ... just as an example, some advertiser might say maximize conversions subject to budget and then our job is to translate that into an assessment of value."); [redacted]

[77] Publishers also seem to be aware that advertisers use the sophisticated algorithms employed by ad buying tools. [redacted]

[78] See "About target ROAS bidding," *Google*, available at https://support.google.com/google-ads/answer/6268637?hl=en (last accessed July 25, 2024); "About optimization score," *Google*, available at https://support.google.com/google-ads/answer/9061546 (last accessed July 25, 2024).

investment ("ROI"),[79] click-through rates ("CTR"),[80] cost per click ("CPC"),[81] and cost per action ("CPA").[82] For ease of exposition, I refer to these various measures as "return metrics." All of these measures relate directly to the advertiser's ultimate advertising objective, which is to increase returns on ad spend.[83] There is strong evidence that advertisers can and do use these return metrics to assess the relative effectiveness of various strategies.[84]

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[79] Return On Ad Spend "measure[s] gross revenue generated for every dollar spent on advertising. A useful metric for determining the effectiveness of an online campaign, ROAS help advertisers gauge what's working and how they can improve future efforts." "Top 10 Retargeting Acronyms to Help You Crush Your Campaigns," *Criteo*, available at https://www.criteo.com/wp-content/uploads/2017/07/Report-criteo-the-smart-marketers-guide-to-retargeting-acronyms-one-pager.pdf (last accessed July 25, 2024); Mayer, Tim, "ROI Vs. ROAS: Which Is The Better Metric For Digital Advertisers?," *AdExchanger*, February 13, 2015, available at https://www.adexchanger.com/data-driven-thinking/roi-vs-roas-which-is-the-better-metric-for-digital-advertisers/ (last accessed July 25, 2024); Beattie, Andrew, "How to Calculate the Return on Investment (ROI) of a Marketing Campaign," *Investopedia*, July 4, 2024, available at https://www.investopedia.com/articles/personal-finance/053015/how-calculate-roi-marketing-campaign.asp (last accessed July 25, 2024) ("The most basic way to calculate the ROI of a marketing campaign is to integrate it into the overall business line calculation. You take the sales growth from that business or product line, subtract the marketing costs, and then divide by the marketing cost."). [redacted]

[80] "In online advertising, the click-through rate (CTR) is the percentage of individuals viewing a web page who view and then click on a specific advertisement that appears on that page. Click-through rates measure how successful an ad has been in capturing users' attention. The higher the click-through rate, the more successful the ad has been in generating interest." Hayes, Adam, "Click-Through Rate (CTR): Definition, Formula, and Analysis," *Investopedia*, December 22, 2022, available at https://www.investopedia.com/terms/c/clickthroughrates.asp (last accessed July 25, 2024). CTR is a common performance metric used by advertisers. [redacted].

[81] "Cost per click (CPC) is an online advertising revenue model that websites use to bill advertisers based on the number of times visitors click on a display ad attached to their sites." "Cost Per Click (CPC) Explained, With Formula and Alternatives," *Investopedia*, June 28, 2023, available at https://www.investopedia.com/terms/c/cpc.asp (last accessed July 25, 2024). CPC is a common performance metric used by advertisers. [redacted]

[82] "Cost per action (CPA) is a pricing model in which marketers pay ad networks or media sources when a user takes a particular action (such as completing a purchase or registration) inside of an app, after engagement with an ad. […] If you spend $1,000 advertising the trial, and 200 people sign up, your CPA is: $1000 / 200 = $5." "Cost per action (CPA)," *AppsFlyer*, available at https://www.appsflyer.com/glossary/cpa/ (last accessed July 25, 2024). CPA is a common performance metric used by advertisers. [redacted]

[83] The exact nature of the return may vary across advertisers and ad campaigns. For example, the objective may be improving brand awareness, increasing visits to the advertiser's webpage, or boosting sales. See, e.g., "How to choose the right ad objective in Meta Ads Manager," *Meta Business Help Center*, available at https://www.facebook.com/business/help/1438417719786914 (last accessed July 25, 2024) ("As your business grows, your campaign goals may change. First, you may want to focus on building awareness and acquiring new customers. Later, you may want to encourage people to make a purchase or sign up for an event. Consider what are the most crucial actions that your potential customers can take in order for you to achieve your current goals.").

[84] [redacted]

48. Advertiser evaluations are also aided by numerous freely available web articles targeted towards small- and medium-sized businesses.[85] These resources detail the process of tracking and optimizing performance metrics to improve digital ad campaigns.[86]

49. Moreover, there is evidence that advertisers not only monitor return metrics, but also use them to learn and optimize their strategies over time. [87] [redacted]

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[85] See, e.g., "How do you know if your marketing campaigns are successful?," *Hotjar*, May 11, 2023, available at https://www.hotjar.com/blog/marketing-campaign-success/ (last accessed July 25, 2024) (suggestions include tracking metrics such as *page traffic*, *leads generated*, *click-through-rate*, *sales*, *return on investment*, *customer retention*, and *brand sentiment*); Tanton, Abbi, "Mastering Campaign Measurement: A Guide for B2B Marketers," *Demand Science*, April 2, 2024, available at https://demandscience.com/resources/blog/ways-to-measure-campaign-success/ (last accessed July 25, 2024); Dougherty, Sean, "Ad campaign optimization: six strategies for success," *Funnel*, February 21, 2023, available at https://funnel.io/blog/six-ad-campaign-optimizations (last accessed July 25, 2024) (including strategies such as "Use A/B testing to determine which of your advertising assets get positive results. You'll likely find [ads'] popularity change over time."); Meyer, Elyse F., "Five Ways To Optimize Your Digital Marketing Strategy," *Forbes*, April 15, 2021, available at https://www.forbes.com/sites/forbesagencycouncil/2021/04/15/five-ways-to-optimize-your-digital-marketing-strategy/ (last accessed July 25, 2024).

[86] For example, see Ben-Meir, Kobi, "Five Key Marketing Metrics For Savvy Small- And Medium-Sized Business Owners," *Forbes*, April 19, 2023, available at https://www.forbes.com/sites/forbescommunicationscouncil/2023/04/19/five-key-marketing-metrics-for-savvy-smalland-medium-sized-business-owners/ (last accessed July 25, 2024); Nichols, Wes, "Advertising Analytics 2.0," *Harvard Business Review*, 2013, available at https://hbr.org/2013/03/advertising-analytics-20 (last accessed July 25, 2024) ("In our experience, these initiatives require five steps, which can be implemented even by small companies.… Fifth, test aggressively and feed the results back into the model. For instance, if your optimization analysis suggests that shifting some ad spending from TV to online display will boost sales, try a small, local experiment and use the results to refine your calculations.").

[87] [redacted] Naylon, Jenna, "Media Planning and Buying Strategies: The Importance of Test & Learn," *MatrixPoint*, available at

[redacted]

50. [redacted]

51. [redacted]

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https://www.thematrixpoint.com/resources/articles/media-planning-and-buying-strategies-the-importance-of-test-learn (last accessed July 25, 2024) ("Applying a systematic approach to 'testing' (running controlled 'what ifs') varying aspects of media campaigns and 'learning' from the results to refine strategies, drive better results, and maximize marketing ROI. The core principle is to iterate and optimize based on data and insights gathered from continuous testing."); "How to Optimize Ad Campaigns: What You Need to Know," *TEC Direct Media*, available at https://tec-direct.com/how-to-optimize-ad-campaigns-what-you-need-to-know/ (last accessed on July 25, 2024) ("This cycle of testing, learning, and optimizing is fundamental to achieving long-term success in digital advertising."); "How can you optimize your digital ads?," *LinkedIn*, available at https://www.linkedin.com/advice/3/how-can-you-optimize-your-digital-ads-skills-advertising (last accessed July 26, 2024) ("Optimizing your digital ads is not a one-time process, but a continuous cycle of learning and improving.").

[88] [redacted]

[89] [redacted]

[90] [redacted]

[redacted]

52. [redacted] The fact that ad buying tools probe auction dynamics is also reflected in internal Google emails and documents about [redacted] (which offers an ad buying tool).[97] For example, Google internal documents indicate that [redacted] conducted experiments and discovered the effects of DRS v2 experiments.[98] In another case, tests run by an advertiser using DV360 in Japan identified the effects of RPO.[99] [redacted]

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94 [redacted]

95 [redacted]

96 [redacted]

97 [redacted]

98 Email from [redacted] Google), "Re: [redacted] Dynamic Pricing on [redacted]," February 12, 2016, GOOG-DOJ-15426012 at -016-018 ([redacted] conducted experiments and discovered the effect of DRS v2 experiments). Google's internal email thread discusses whether the effect discovered was from RPO or DRS. See *ibid* (email from [redacted] stating that "Our team has found data suggesting that there is dynamic pricing on [redacted]. It looks like dynamic pricing starts from [redacted]."); *id*. at -017 (email from [redacted] (Google) stating "Essentially it looks like they've discovered reserve price optimization feature and are asking questions" and another Google employee noting "I do believe this is DRS v2"); see GOOG-DOJ-29803801 at -809 ("[redacted] has only observed DRS v2 in experiment but have hinted at further data that may or may not include RPO.").

99 GOOG-DOJ-05311280 at -281 (email on March 11, 2016, from [redacted] (Google), stating "One of DBM Japan's advertisers, [redacted], has noticed that their winning prices are all coming in just under their bid price (which is set at [redacted] across three campaigns). The expected win price is somewhere in the order of [redacted]

[redacted]

53. Consistent with the industry evidence and the academic literature, there is also evidence that some Google employees believed that if advertisers and their bidding tools were faced with a change from second-price to first-price auctions, "most DSP's [sic] bidding algorithms would be able to adapt gracefully and that GDN could adapt as well, given a quarter or two of lead time."[101]

b. Advertisers Rely on Sophisticated Advertising Agencies

54. The *second* factor that facilitates learning by advertisers is that advertisers can and often do rely on the services of sophisticated[102] advertising agencies[103] to provide expertise,

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yen, because the bid prices are so high (and their [sic] know it)."); *id.* at -287-288 (email on February 29, 2016, from [redacted] (Google Marketing Team), explaining that the same advertiser conducted additional tests on DV360 and non-AdX inventory to isolate the effect to AdX and DV360: "One more thing; We are running the same research with non-AdEx [sic] inventories via DBM now. However, it shows normal distributions of winning price and seems to work as we expect. So, [redacted] see also GOOG-DOJ-29803801 at -801 and -810 ("Due to recent buyer observations it is possible reactive comms will be needed before the planned announcements of the project" because "DBM researchers … working with [redacted] have noticed RPO effects using DBM tests. The results were shared with the [redacted]

[100] [redacted]

[101] GOOG-DOJ-13350192 at -197; see also GOOG-AT-MDL-018632411 at -421 (Google's internal presentation on "First Price Auction & Unified Floors" stating "Since it will be a 1st price auction then Authorized Buyers are likely to adjust their bids downwards over time"); Goke, et al. (2022).

[102] [redacted]

[103] FAC ¶¶ 73 and 198 concede that agencies are involved. Deposition testimony and advertiser documents also demonstrates that advertisers commonly hire ad agencies. [redacted]

optimization tools, and return metrics to help them maximize return on ad spend.[104] These agencies help advertisers design ad campaigns,[105] manage their budgets,[106] develop the

[redacted]

104 [redacted]

105 [redacted]

constraints and objectives provided to ad buying tools,[107] and assess returns.[108] These agencies integrate information on campaign performance, giving advertisers ready access to salient information.[109] When advertisers multi-home with different ad buying tools, agencies can and do provide comparative information about performance and recommendations about how to reallocate budgets,[110] which facilitates competition across ad buying tools.

55. For example, [redacted], Chief Innovation and Product Solution Officer at [redacted] (an ad agency that [redacted]), testified that [redacted].[111]

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107 [redacted]

108 [redacted]

109 [redacted]

110 [redacted]

111 [redacted]

56. [redacted], Senior Vice President and Managing Director at [redacted] (another ad agency), testified that [redacted].[112]

57. [redacted], Chief Operating Officer at [redacted] (a global advertising agency), testified that [redacted]"[113]

58. [redacted], Head of Programmatic at [redacted] (a global marketing and advertising agency), testified that [redacted][114] In

[redacted]

112 [redacted]

113 [redacted]

114 [redacted]

[redacted][115]

59. Similarly, [redacted], Global Head of Product at [redacted], (an ad agency)[116] testified that [redacted].[117]

60. The ad agency [redacted] recommends that advertisers [redacted][118]

[redacted]

[115] [redacted]

[116] [redacted]

[117] [redacted]

[118] [redacted]

61. [redacted], a U.S.-based [redacted] manufacturer, uses the ad agency [redacted] to optimize its ad campaigns. [redacted] produces reports for [redacted] of [redacted].[119]

62. [redacted] hired [redacted] for a campaign in October 2020. [redacted].[120]

c. Competitive Pressure Incentivizes Ad Buying Tools to Continually Learn and Optimize Their Bidding Strategies

63. The *third* important feature of this industry is that competitive pressure on ad buying tools, along with many advertisers' simultaneous use of multiple ad buying tools, incentivizes ad buying tools to continually learn and optimize their bidding strategies. Because many advertisers simultaneously use multiple ad buying tools and because those advertisers and advertising agencies closely monitor and compare returns of ad buying tools, if an ad buying tool is not bidding effectively, it will likely be out-competed by an alternative that offers advertisers lower costs and higher returns.[121] In this way, advertisers' (and their ad agencies') focus on performance creates competitive pressure on ad buying tools to optimize their strategies. These competitive pressures create strong incentives for ad buying tools to keep secret any innovative strategies or optimizations that they develop to

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[redacted]

119 [redacted]

120 [redacted]

121 [redacted]

help advertisers maximize their returns.[122]

64. There is ample evidence that advertisers use multiple ad buying tools, a practice known as "multi-homing."[123] For example, research company [redacted] found that, in the first half of 2022, about [redacted] percent of surveyed advertisers anticipated using four or more DSPs, with an additional [redacted] percent planning to use three, [redacted] percent planning to use two, and only [redacted] percent planning to use one DSP.[124] The prevalence of multi-homing means that advertisers can easily compare returns across ad buying tools, and shift advertising resources to the tools that perform best. Indeed, internal Google documents note that "[w]e also know that buyers are buying across all these companies simultaneously, and don't seem to care that much which one they ultimately buy on, as long as they're getting good ROI."[125] Multi-homing and the ability to compare returns across platforms mean that advertisers are well-positioned both to detect changes in returns and shift resources accordingly.[126]

65. Testimony from industry participants affirms that advertisers and advertising agencies evaluate and compare the performance of different ad buying tools in deciding how and

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[122] Economics recognizes trade secrets as an important economic phenomenon. One study defines a trade secret as "an item of information … that has commercial value and that the firm possessing the information wants to conceal from its competitors in order to prevent them from duplicating it." Friedman, David D., William M. Landes, and Richard Posner, "Some Economics of Trade Secrets," *Journal of Economic Perspectives*, Vol. 5, No. 1, 1991, pp. 61-72 at 61. Scholars note that "Some of the best-known names among consumer products are based on intellectual property protected by trade secrecy," including Coca Cola and Kentucky Fried Chicken. See Cass, Ronald A. and Keith N. Hylton, "Trade Secrets," *Laws of Creation*, Harvard University Press, 2013, pp. 76-96 at 76. Another study argues that digital technology is one of the reasons why trade secrets have been increasingly important. See Almeling, David S., "Seven Reasons Why Trade Secrets are Increasingly Important," *Berkeley Technology Law Journal*, Vol. 27, No. 2, 2012, pp. 1091-1117.

[123] See Expert Report of Dr. Itamar Simonson, July 30, 2024, at ¶¶ 109-110 (survey results indicate that approximately 75% of higher-spend advertisers multi-home on ad buying tools for programmatic display ads); *id.* at ¶¶ 158-159 (survey results indicate that 80% of lower-spend advertisers multi-home on ad buying tools for display ads); *id.* at ¶¶ 205-206 (survey results indicate that approximately 73% of ad agencies multi-home on ad buying tools for programmatic display ads); see also *id.* at ¶ 18, Figure 4 (presenting survey results on multi-homing across different types of digital advertising and display ad buying tools).

[124] GOOG-AT-MDL-008928829 at -875. For additional evidence of multi-homing among ad buying tools, see, e.g., [redacted]

[125] Email from Jonathan Bellack (Google), "Re: [drx-pm] Op-ed that RTB should move to first price auction – what do you think?," August 6, 2015, GOOG-DOJ-13350192.

[126] [redacted]

where to allocate their advertising dollars. For example, [redacted], Director of [redacted] at [redacted], testified that [redacted].[130]

66. Similarly, [redacted], Senior Vice President of [redacted] at [redacted], testified that [redacted]."[132]

67. [redacted], Product Manager at [redacted], [redacted] testified that [redacted]

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127 [redacted]

[redacted]

68. [redacted]

69. The competitive pressure that advertiser monitoring and learning places on ad buying tools incentivizes those tools to learn and adapt to industry changes. The tools that adapt most effectively are rewarded with more customers. This fact is reflected in a Google email discussing the potential move to a first-price auction: "It's tempting to assume that many of the [] [DSPs] are not smart/rational enough, so they won't adapt [their bidding strategy] and therefore the value can be captured for the seller. But, what matters is not how smart they are now. Since DSPs ultimately compete against each other for advertiser dollars, those that don't adapt their strategies will obviously have higher cost for the same

133 [redacted]

134 [redacted]

135 [redacted]

136 [redacted]

value delivered to their customers, so they will shrink to irrelevance, and the demand that matters will have adapted."[137]

d. Frequency and Amount of Feedback Facilitates Learning

70. The *fourth* important feature of this industry that facilitates learning is that advertisers and the advertising agencies and ad buying tools they use all receive continuous and meaningful amounts of feedback over relatively short periods of time.[138] This enables

[137] Email from Nemo Semret (Google), "Re. [drx-pm] Op-ed that RTB should move to first price auction – what do you think?," August 5, 2015, GOOG-DOJ-13350192 at -195-196.

[138] Advertisers on Google Ads (formerly, AdWords) received campaign-level data on metrics such as impressions, views, traffic, clicks, cost, click-through-rate, and conversions as early as 2013. See "AdWords for video makes reporting more insightful, purposeful and beautiful," *Google*, January 30, 2013, available at https://adwords.googleblog.com/2013/01/ (last accessed July 25, 2024). Currently, both Google Ads and DV360 report performance on several metrics (conversions, click-through-rate, CPM, clicks, average cost-per-click) to aid advertisers' decision-making. See "Use auction insights to compare performance," *Google Ads Help*, available at https://support.google.com/google-ads/answer/2579754 (last accessed July 25, 2024); "Measure results," *Google Ads Help*, available at https://support.google.com/google-ads/topic/3119141 (last accessed July 25, 2024); "Metrics in reports," *Google Display & Video 360 Help*, available at https://support.google.com/displayvideo/table/3187025 (last accessed July 25, 2024). Google's analytics tools also provide significant feedback (on metrics such as user acquisition, traffic acquisition, conversions, purchase activity etc.) to both small- and large-business advertisers on their campaign performance. See "Google Marketing Platform," *Google*, available at https://marketingplatform.google.com/about/ (last accessed July 25, 2024). Moreover, when Google transitioned its ad exchange to a first-price auction, Google started providing bidders with data on the minimum bid to win ("MBTW"), which is the minimum value that the bidder would have needed to bid to win the auction. Google did so because "[b]idding in first price auctions is fundamentally harder than bidding into second price auctions," GOOG-DOJ-00216457 at -465, and the provision of MBTW data aids buyers in "train[ing] [their] per-query bidding models" for future auctions. "Ad Manager Data Transfer reports," *Google Ad Manager Help*, available at https://support.google.com/admanager/answer/1733124 (last accessed on July 25, 2024) (providing a detailed listing of the "non-aggregated, event-level data from [advertisers'] ad campaigns" that Google provides to bidders).

Other platforms also provide data on several metrics for advertisers to measure performance across campaigns and creatives. See, e.g., "Advertiser analytics," *Microsoft Xandr Platform*, March 5, 2024, available at https://learn.microsoft.com/en-us/xandr/digital-platform-api/advertiser-analytics (last accessed July 25, 2024) (providing information on metrics such as impressions, CPM, cost-per-click, conversion rate, video completion rate, cost per video completion etc.); "How to use Audience performance report," *Criteo*, available at https://help.criteo.com/kb/guide/en/audience-performance-report-9sG6Wef3qz/Steps/775752,1863384 (last accessed July 25, 2024) (providing information on metrics such as exposed users, visits, displays, clicks, sales, revenue, and cost-per-view). Several third-party tools also allow advertisers (including small advertisers) to monitor and optimize campaigns, run A/B tests, and manages budgets. See, e.g., "Take your PPC automation to the next level," *Adalysis*, available at https://adalysis.com/features/ (last accessed July 25, 2024); "PPC Reporting Capabilities," *Optmyzer*, available at https://www.optmyzr.com/solutions/reporting (last accessed July 25, 2024). Advertisers also testified that [redacted]

advertisers (and their agencies) to continuously evaluate the feedback they receive with respect to the various return metrics.[139] As the academic literature notes, such experience and feedback facilitate learning in auction settings, as well as more generally.[140]

e. Ability to Run Experiments Facilitates Learning

71. The *fifth* important feature of this industry that facilitates learning is the ability to run experiments. Such experiments are "generally considered to be the gold standard for drawing inference on causal effects."[141] In a recent book on the role of experiments in business, Harvard Business School professors Michael Luca and Max Bazerman stated that "perhaps no sector has embraced the experimental method more than the tech sector, where it is now a standard component of managerial decision making."[142]

72. Advertisers can experimentally change the maximum they are willing to pay for a click or an impression, as well as other campaign parameters, to determine whether such changes

[redacted]

139 [redacted]

140 The conventional literature on learning in auctions indicates that experience increases with the number of auctions in which a participant bids. See Wang Xin and Ye Hu, "The Effect of Experience on Internet Auction Bidding Dynamics," *Marketing Letters*, Vol. 20, No. 3, 2009, pp. 245–261; Goke, et al. (2022); Pownall, Rachel A.J. and Leonard Walk, "Bidding Behavior and Experience in Internet Auctions," *European Economic Review*, Vol. 61, No. 1, 2013, pp. 14-27. More generally, greater feedback speeds learning. See Wieland, Volker, "Learning by Doing and the Value of Optimal Experimentation," *Journal of Economic Dynamics and Control*, Vol. 24, 2000, pp. 501-534; Bandiera, Oriana, Valentino Larcinese, and Imran Rasul, "Blissful ignorance? A natural experiment on the effect of feedback on students' performance," *Labour Economics*, Vol. 34, 2015, pp. 13-25; Benkard, Lanier C., "Learning and Forgetting: The Dynamics of Aircraft Production," *American Economic Review*, Vol. 90, No. 4, 2000, pp. 1034-1054; Darr, Eric D., Linda Argote and Dennis Epple, "The Acquisition, Transfer, and Depreciation of Knowledge in Service Organizations: Productivity in franchises," *Management Science*, Vol. 41, No. 11, 1995, pp. 1750-1762.

141 Mattei, Alessandra, Fabrizia Mealli, and Anahita Nodehi, "Design Analysis of Experiments," in Klaus Zimmerman, *Handbook of Labor, Human Resources and Population Economics*, Springer, 2022, pp. 1-4 ("Randomized experiments are generally considered to be the gold standard for drawing inference on causal effects; carefully designed and executed randomized experiments guarantee that, in expectation, there are no systematic differences between those units who were exposed to the treatment and those who were not, and thus simple comparisons of treatment and control units have a causal interpretation.").

142 See Luca, Michael and Max H. Bazerman, *The Power of Experiments: Decision Making in a Data-Driven World*, Cambridge: MIT Press, 2021, at 62 ("But perhaps no sector has embraced the experimental method more than the tech sector, where it is now a standard component of managerial decision making.").

help them better achieve campaign objectives. For example, [redacted] conducted [redacted][143] [redacted]

73. Amy Corner, Vice President for [redacted] at [redacted], testified that [redacted].[145]

74. David Williams, Associate Managing Director at Utah Office of Tourism testified to running several kinds of experiments, including A/B tests, before launching a campaign to evaluate what does and does not work.[146]

75. Similarly, [redacted] at [redacted] testified that [redacted]

[redacted]

[redacted]

[redacted] [redacted]

77. The net impact of these five features of the Ad Tech industry is that advertisers need not understand the various bidding strategies that are implemented on their behalf, nor how the precise dynamics of any auction impact the effectiveness of the strategies of ad buying tools. Rather, advertisers can monitor and test their tools' performance with regard to various return metrics and shift their advertising budgets in pursuit of the highest returns available.

78. There is, moreover, considerable evidence that many advertisers do *not* focus on auction dynamics or on the particular strategies used by ad buying tools to bid into auctions. For example, the Communications Director at [redacted] who purchases digital advertisements for the agency's advertising campaigns, testified that [redacted].[154]

[redacted]

79. [redacted] of the [redacted] testified that [redacted].[155] [redacted].[156]

80. [redacted], VP for Strategic Communications at [redacted], testified that [redacted][157]

81. While [redacted], Associate Managing Director at [redacted], testified that [redacted]

[redacted]

[redacted],[159] [redacted].[160]

82. [redacted], Public Information Officer at [redacted], testified that [redacted][161] [redacted].[162]

3. Publisher Learning

83. Many of the same features that impact advertiser behavior have parallel impacts on publishers. As with advertisers, these factors facilitate learning and have direct implications for understanding the impact of Google's alleged deception. These factors include: (a) publishers' focus on the revenue generated by impressions, and their ability to continually learn and adapt to maximize their returns; (b) publishers' reliance on the services of companies providing sophisticated optimization tools to help them optimize their returns; (c) publishers' common use of multiple exchanges to create competition for their business and increase their returns; and (d) the continuous and voluminous feedback publishers receive over short periods of time, which enhances learning and optimization.

[redacted]

[redacted]

[redacted]

[redacted]

As with advertisers, the net impact of these factors is that publishers need not attempt to master every aspect of the auctions in which they participate or perfectly understand the strategies in which intermediaries engage on their behalf.

a. Publishers Use Various Measures of Return to Learn and Adapt

84. The *first* important feature is that publishers, like advertisers, focus on various measures of return and continually use those measures to learn and adapt.[163] Publishers focus on measures including, but not limited to, revenue per impression, revenue per visit, and revenue per click.[164] Publishers' focus on returns is reflected in an exchange between [redacted] and Google, which begins with "[w]e've noted a sharp decline in [redacted] performance starting from late last month."[165] Summarizing the [redacted] it continues "[w]e note a much larger decline in [redacted]

163 [redacted]

164 [redacted]

165 [redacted]

[redacted][166] A similar focus on returns is reflected in an internal document at [redacted] comparing impressions sold, revenue generated [redacted] s [redacted][167] [redacted] publisher team also continuously monitors [redacted].[168]

85. There is evidence that publishers use these measures to assess and compare the effectiveness of different strategies. [redacted]

b. Publishers Rely on Sophisticated Intermediaries

86. The *second* factor that facilitates learning and adaptation by publishers is that ad servers and other intermediaries provide sophisticated tools that help publishers optimize their returns. For example, it is common for intermediaries to offer dynamic floor pricing to

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[redacted]

improve the performance of publisher inventory.[173] [redacted] ad exchange uses [redacted] [redacted] and has done so since as early as [redacted].[174] [redacted][175] and [redacted][176] also use [redacted], as does [redacted] ad server.[177] Google itself offered Reserve Price Optimization to help publishers set price floors that generated better returns.[178] When one publisher was losing auctions due to high price floors, Google reached out proactively to suggest that the publisher use Google's automated tool for optimizing price floors or that it test alternative price floors itself using Google's manual experiments tool.[179]

[173] See Picard, Eric, "Publishers, Don't Settle for Below-Floor Pricing," *AdExchanger*, November 1, 2023, available at https://www.adexchanger.com/the-sell-sider/publishers-dont-settle-for-below-floor-pricing/ (last accessed July 25, 2024) ("Supply-side platforms (SSPs) were born to protect publishers' interests in an automated auction environment. They introduced features like dynamic floor pricing to ensure that demand-side platforms (DSPs) pass on their best bids into the auction.").

[174] [redacted]

[redacted]

[redacted]

[redacted]

[178] GOOG-DOJ-04937154 at -155 ("Optimized pricing in the Open Auction automates the post-auction analysis and floor price updates that publishers are already doing and takes it a step further.… Open auctions tend to have a large price gap between what a buyer bids, and what they pay. As result, publishers have created complex systems of publisher-set floors to close the gap. Unfortunately, these floors are hard to calculate manually, requiring ad ops teams to spend countless hours gathering data and running post-auction analysis to update pricing and priorities in their system. Some publishers have even resorted to more extreme methods like waterfalls between exchanges, which introduces latency that damages consumer experience and advertiser performance. And even with all this effort, there is still a wide and persistent price gap between the bid and closing prices in the open auction across all our publishers. We think there is a better way. Optimized pricing effectively reduces the gap between the first price and closing price increasing publisher yield.").

[179] After UPR was introduced, Google's representative noticed a publisher client losing auctions due to high floor prices. The representative made suggestions on how the publisher could adjust the bid floor and increase its revenue. [redacted]

87. Other companies also offer solutions that help publishers maximize revenue from ads. For example, [redacted] offers technological solutions for [redacted].[180] Maxifier offers several solutions to increase publishers' CPM and revenue, including prediction of campaign performance, optimization based on performance metrics, simulation and testing of changes in campaigns before implementation, and automation of optimization processes.[181] MonetizeMore offers AdX optimization, AdSense optimization, custom revenue stream recommendations, and reconciliation of discrepancies between publisher's and partner's impression counts.[182] Inventale offers forecasting of ad inventory,[183] monitoring of campaign performance,[184] and optimized yield management.[185] Clickio offers price floor optimization and automated mediation between bids to "guarantee maximum revenues."[186] Adomik offers publishers that it can "collect and organize revenue data from ad servers, ad exchanges, and header bidding partners," and also "delivers aggregated visibility and insights into their monetization for [p]ublishers to increase their yield."[187]

88. In addition, [redacted] produces newsletters with market-wide analysis that can help publishers decide whether and how to shift inventory across ad exchanges. For example, "[redacted]

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[180] [redacted] "Make every use worth more," *Verve Group*, available at https://verve.com/publishers/ (last accessed July 25, 2024). "Fill rate is a key performance indicator (KPI) in digital advertising that measures the percentage of ad requests successfully filled with ads. It represents the efficiency with which publishers utilize their ad inventory, helping advertisers and publishers assess the effectiveness of their advertising campaigns and inventory management. In simpler terms, fill rate quantifies how well a publisher is able to match the available ad inventory with relevant ads from advertisers. A higher fill rate generally indicates better ad inventory utilization and a more effective advertising strategy," "What is Fill Rate? Definition, Types, & Calculations," *AdQuick*, available at https://www.adquick.com/adtech/fill-rate (last accessed July 25, 2024).

[181] "Maxifier for Publishers," *Maxifier*, available at https://maxifier.com/maxifier-for-publishers/ (last accessed July 25, 2024).

[182] "Your site is unique. Your ad optimization should be too," *MonetizeMore*, available at https://www.monetizemore.com/# (last accessed July 25, 2024).

[183] "Forecasting," *Inventale*, available at https://inventale.com/en/forecasting/ (last accessed July 26, 2024).

[184] "Monitoring," *Inventale*, available at https://inventale.com/en/monitoring/ (last accessed July 25, 2024).

[185] "Yield Management," *Inventale*, available at https://inventale.com/en/yield-management/ (last accessed July 25, 2024).

[186] See "Maximize Revenue, Minimize Hassle," *Clickio*, available at https://clickio.com/monetization/ (last accessed July 25, 2024) (offering "Price Floor Optimization" and "Google AdSense Mediation").

[187] "Smart Advertising Analytics: To turn insights into revenue," *Adomik*, available at https://www.adomik.com/ (last accessed July 25, 2024) (emphasis omitted).

[redacted][188]

c. Publishers Multi-Home

89. The *third* factor that facilitates learning and adaptation by publishers is that they often use multiple ad exchanges to sell their inventory. In 2020, [redacted] reported that "publishers use [redacted] SSPs and plan to [redacted] in 2021," and even [redacted] reported using an average of [redacted] SSPs.[189] Plaintiffs themselves recognize that publishers compare returns and performance of the multiple ad exchanges they use, and that such comparisons and multi-homing enable publishers to shift inventory among exchanges accordingly to maximize returns.[190]

90. For example, [redacted], Head of Advertising at [redacted] (a magazine and digital media publisher) testified that [redacted]

[188] [redacted]

[189] GOOG-AT-MDL-004170032 at -037. The importance of publisher multi-homing was an element that the DOJ highlighted in its investigation of Google's acquisition of Admeld: "[t]he investigation determined that web publishers often rely on multiple display advertising platforms and can move business among them in response to changes in price or the quality of ad placements. This use of multiple display advertising platforms, commonly called 'multi-homing,' lessens the risk that the market will tip to a single dominant platform." "Statement of the Department of Justice's Antitrust Division on Its Decision to Close Its Investigation of Google Inc.'s Acquisition of Admeld Inc.," *Department of Justice*, December 2, 2011, available at https://www.justice.gov/opa/pr/statement-department-justices-antitrust-division-its-decision-close-its-investigation-google (last accessed July 25, 2024).

[redacted]

[redacted]

91. Other publishers, [redacted] and [redacted], regularly [redacted]. For example, [redacted] [193]

92. [redacted] works with multiple ad exchanges that programmatically sell its ad inventory. [redacted] Vice President of Revenue Operations & Analytics at [redacted] testified that [redacted]

191 [redacted]

192 [redacted]

193 [redacted]

194 [redacted]

[redacted]

93. Similarly, [redacted][198]

d. Frequency and Amount of Feedback Facilitates Learning

94. The *fourth* factor that facilitates learning by publishers is the high volume of feedback that publishers receive over time.[199] For example, publishers in aggregate sell over [redacted]

[redacted]

195 [redacted]

196 [redacted]

[redacted]

199 Publishers on AdX have received ad unit level data as on metrics such as minimum CPM, and auction price as early as 2012. See "PubTalk: PCH's Denise Leggio on winning big with DoubleClick Ad Exchange," *DoubleClick Publisher Blog*, April 24, 2012, available at https://doubleclick-publishers.googleblog.com/2012/04/ (last accessed July 25, 2024) ("From reporting features at the individual ad unit level, to the Minimum CPM Recommendation tool to set the minimum auction price, AdX has provided Denise's team many tools to optimize revenue. 'The optimization options have been extremely valuable for our online business. The tools, reports and data provided give us insight into our inventory and buyer habits,' she says. 'With those insights, we're able to make changes extremely quickly.'"); [redacted]

impressions per month.[200] This enables publishers to obtain a continuous view of their returns, as well as quick feedback in response to changes or experiments they implement.[201] [redacted][202] Google's guide for publishers during the introduction of UPR recommended "testing and optimizing" as a means of setting an optimal price floor, and encouraged publishers "to run a manual experiment on an existing UPR with a fixed or Target CPM. To get the most reliable results, we would recommend running A/B experiments on at least 50% of traffic for a minimum of two weeks."[203]

95. As with advertisers, the net impact of these factors is that publishers need not attempt to master the details of auction dynamics or the bidding strategies used by ad buying tools. Instead, consistent with basic economic theory, a Google email aptly describes publisher behavior: "[a]t the end of the day pubs care about yield, they don't care the slightest about auction dynamics."[204]

[redacted] See "Ad Manager report metrics," *Google Ad Manager Help*, available at https://support.google.com/admanager/table/7568664 (last accessed July 25, 2024). Furthermore, publishers routinely use services of third-party companies. See, e.g., "Maxifier for Publishers," *Maxifier*, available at https://maxifier.com/maxifier-for-publishers/ (last accessed July 25, 2024); "Are you leaving Ad Revenue on the table?" *MonetizeMore*, available at https://www.monetizemore.com/# (last accessed July 25, 2024); "Forecasting," *Inventale*, available at https://inventale.com/en/forecasting/ (last accessed July 26, 2024); "Monitoring," *Inventale*, available at https://inventale.com/en/monitoring/ (last accessed July 25, 2024); "Yield Management," *Inventale*, available at https://inventale.com/en/yield-management/ (last accessed July 25, 2024); "Price Floor Optimization" and "Google AdSense Mediation," *Clickio*, available at https://clickio.com/monetization/ (last accessed July 25, 2024); "Smart Advertising Analytics: To turn insights into revenue," *Adomik*, available at https://www.adomik.com/ (last accessed July 25, 2024).

200 [redacted]

201 For example, note that "Real Time Bidding has pushed publisher ad ops teams to develop increasingly complex strategies to segment and price inventory. [Publisher] Ad Ops teams have typically run post-auction analysis to inform updates to floor prices across all their inventory and to set prices for all their demand partners." GOOG-TEX-00585243 at -244.

202 [redacted]

203 [redacted]

204 Email from Drew Bradstock (Google), August 5, 2015, "Re: [drx-pm] Op-ed that RIB should move to first price auction -- what do you think?," GOOG-DOJ-13350192 at -198.

III. Mr. Andrien Fails to Follow His Own Framework and Proposes Vastly Overstated DTPA Civil Penalties

96. I begin this section by briefly reviewing the plaintiffs' DTPA claims that Mr. Andrien discusses in his report. I then describe Mr. Andrien's framework for determining what he considers to be appropriate DTPA civil penalties.[205] I also describe how Mr. Andrien does not even attempt to apply his own framework, which requires a calculation of the benefits Google received from the alleged deception, but instead implements an entirely ad hoc set of calculations. I conclude this section with a brief discussion of how Mr. Andrien's calculations vastly overstate any penalties that could result from the application of his framework.

A. Overview of the Alleged Deception

97. Mr. Andrien proposes DTPA civil penalties for Google's alleged deception about Reserve Price Optimization (RPO), Dynamic Revenue Sharing (DRS), and Project Bernanke "and their various iterations"[206] and for publicly "represent[ing] that it ran a transparent auction where all bidders on Google's ad exchange competed on equal footing."[207] I briefly introduce each of those claims here and provide detailed analyses of each in Sections IV-VII of this report.

98. With regard to RPO, DRS, and Bernanke, the plaintiff States assert that "Google failed to properly disclose these programs (or disclose them at all) and misled publishers and advertisers about their existence and effects."[208] Mr. Andrien claims that "starting at least as early as 2010 and running through September 2019, Google represented to both publishers and advertisers that AdX was operated as a second-price auction. . . . However, through various Google programs implemented starting in at least 2013, I understand that Google manipulated the auction process such that AdX auctions could no longer be characterized as they were represented, including through RPO, DRS, and Project Bernanke and their various iterations."[209]

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[205] Andrien Report at ¶ 106.

[206] Andrien Report at ¶ 29.

[207] Andrien Report at ¶ 51.

[208] FAC ¶ 526.

[209] Andrien Report at ¶ 29.

99. RPO employed information about bidders' past bids to establish floor prices in subsequent auctions. Its purpose was to help publishers increase their revenue and encourage them to make more high-quality inventory available.[210] According to Mr. Andrien, Google concealed RPO from both advertisers and publishers until its announcement of the program in May 2016.[211] He asserts that this concealment led to an increase in the average clearing price in AdX auctions to the detriment of advertisers.[212] He also asserts that Google's alleged concealment of RPO "prevented publishers from effectively optimizing revenue," and "might [cause publishers to] set suboptimal reserves on any impression for which RPO may have been active."[213]

100. DRS dynamically changed the AdX revenue share on an auction-by-auction basis to permit more AdX auctions to clear.[214] Another one of plaintiffs' experts, Professor Matthew Weinberg, asserts that second-price auctions lead bidders to bid amounts equal to their true values,[215] and Mr. Andrien asserts that AdX auctions to which the first two versions of DRS (known as "DRS v1" and "DRS v2") applied were not "true" second

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[210] See GOOG-DOJ-04937154 at -155 and 159 (explaining that Optimized Pricing, the external name for RPO, uses historic bids to set floor prices in order to "reduce[] the gap between the first price and closing price increasing publisher yield" and "could encourage publishers to make more inventory accessible to the open auction.").

[211] Andrien Report at ¶¶ 31-32 ("Google did not announce this [RPO] program to its customers prior to its launch. In fact, Google did not announce the program until May 12, 2016, over a year after its initial rollout, which it announced in a blog post under the name "optimized pricing.").

[212] Andrien Report at ¶ 35 ("Google also impacted advertiser behavior through its second-price auction representation and concealment of RPO. Namely, I understand that Google's representation that it was running a second-price auction encouraged advertisers to bid their true value for impressions, which over time caused later AdX reserve prices to increase, which, in turn, led to a payoff loss for advertisers by decreasing win rates and increasing the average clearing price in later AdX auctions.") In support of this claim, Mr. Andrien relies on Professor Weinberg, who claims, *inter alia*, that "if the advertiser were aware of RPO, they would have shaded their bid." *Ibid.* (citing Weinberg Report at ¶ 285).

[213] Andrien Report at ¶ 34.

[214] See, e.g., GOOG-DOJ-15130321 at -321 (explaining that "DRS is an optimization feature that increases publisher and Google revenue by dynamically changing the AdX sell-side revenue share so that more auctions end with a winning buyer. V1 decreased Google's revenue share to grow revenue overall. V2 adjusts Google's revenue share more aggressively, by decreasing and increasing the Google share on different impressions, to increase the number of AdX auctions with a winning buyer while always achieving the publisher's contracted revenue share (typically [redacted]%) or higher for each billing period."); GOOG-DOJ-04937543 at -543 (explaining that the second version of DRS "decreas[ed] and increas[ed] the Google share on different impressions, to increase the number of AdX auctions with a winning buyer," with the goal of maintaining Google's AdX average revenue share across all transactions).

[215] See Weinberg Report at ¶ 47 ("A sealed bid single-item auction is truthful if each bidder receives the best possible outcome (given the other bidders' bids) by submitting a bid equal to their own value"); *id.* at ¶ 47 ("Second-price auctions are truthful, and this is one of their key advantages in comparison to first-price auctions.").

price auctions.[216] Mr. Andrien further contends that Google's failure to disclose DRS was deceptive because "by leading advertisers to believe the AdX auction was a standard second-price auction, advertisers would engage in suboptimal behavior,"[217] including continuing to bid as they would in true second-price auctions instead of shading (i.e., lowering) their bids.[218] Mr. Andrien also claims that, "but for Google's omissions, publishers who believed that AdX ran a standard second price auction would have set different reserve prices if they had been aware of DRSv1" and that "[t]he same is true for DRS v2."[219]

101. Mr. Andrien contends that Project Bernanke modified the two bids that Google Ads submitted into the AdX auction by (i) increasing Google Ads' high bid to win more impressions, and (ii) decreasing (or removing) Google Ads' low bid.[220] The reduction or removal of the low bid reduced the AdX clearing price for impressions when Google Ads' high and low bids were the top two bids.[221] Mr. Andrien contends that Google's failure to disclose Bernanke was deceptive because, had it been disclosed, publishers likely would have raised their reserve prices and advertisers likely would have shaded their bids.[222] Instead, he asserts that "advertisers thought they were participating in a true second price auction"[223] and bid their "true values."[224]

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[216] See Andrien Report at ¶ 38 ("I … understand that with DRSv1, AdX did not run a true second price auction"); *id.* at ¶¶ 41-42 ("I understand that by not revealing DRSv1 and leading advertisers to believe the AdX auction was a standard second-price auction, advertisers would engage in suboptimal behavior. For example, if advertisers had known of DRSv1, they could shade their bids to get a higher return. The same is true of DRSv2."). Mr. Andrien refers to Professor Weinberg's expert report as his basis for reaching these conclusions. See Andrien Report at ¶¶ 38, 41-42.

[217] Andrien Report at ¶ 41.

[218] See Andrien Report at ¶¶ 41-42 ("I understand that by not revealing DRSv1 and leading advertisers to believe the AdX auction was a standard second-price auction, advertisers would engage in suboptimal behavior. For example, if advertisers had known of DRSv1, they could shade their bids to get a higher return. The same is true of DRSv2.").

[219] Andrien Report at ¶ 41.

[220] Andrien Report at ¶ 44.

[221] GOOG-DOJ-13469175 at -175 ("As part of Project Bernanke, we reduce the second bid (and in some cases drop the second bid completely) and create a pool of money, which we then reinvest by increasing the first bid on queries in order to win potentially unmatched queries. This is done in such a way that GDN profit is maximized while also ensuring fair GDN payout to the exchange/ publisher. Here, fairness is defined as ensuring the desired margin [typically 14%] on the GDN payout.").

[222] Andrien Report at ¶ 46.

[223] Andrien Report at ¶ 46.

[224] Andrien Report at ¶ 46.

102. Mr. Andrien also argues for DTPA civil penalties in connection with what he calls Google's "Equal Footing" misrepresentation.[225] According to Mr. Andrien, in 2019, Google "publicly represented that it ran a transparent auction where all bidders on Google's ad exchange competed on equal footing."[226] He further claims that representation was deceptive because Alchemist (a successor to Bernanke) gave advantages to Google Ads and because Facebook also received advantages under its Network Bidding Agreement (NBA) with Google.[227]

B. Mr. Andrien's Framework for Determining DTPA Civil Penalties

103. Mr. Andrien lays out the following framework for determining civil penalties. "To deter Google from continuing its misconduct, the penalty must eliminate Google's financial incentive to engage in the misconduct. At minimum, this would involve penalizing Google for the total incremental benefits (including future benefits) from the alleged misconduct."[228] He later repeats that idea, asserting that, "[f]rom a financial and economic perspective, to deter future violations, the total penalty must eliminate Google's financial incentive to engage in the alleged misconduct.... One way to frame the appropriate amount to deter future bad behavior is to consider an approach that penalizes Google *for at least the benefits it gained associated with the alleged misconduct*."[229] In this report, I refer to the "approach that penalizes Google for at least the benefits it gained associated with the alleged misconduct" as Mr. Andrien's "framework."

104. Mr. Andrien develops his framework by identifying two types of direct benefits that Google might receive from its alleged misconduct. First, he contends that "Google directly benefits from its misconduct every time an auction clears on AdX that would not have cleared but-for the misconduct."[230] Second, he asserts that Google benefits "if the clearing price was higher than it would have been absent the misconduct."[231] Economists describe

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[225] Andrien Report at ¶¶ 51-54 (referring to alleged "equal footing" offenses); *id.* at ¶ 99 (referring to "Equal Footing/AdX Fairness").

[226] Andrien Report at ¶ 51.

[227] Andrien Report at ¶¶ 51-54; see also *id.* ¶ 47 (discussing Alchemist).

[228] Andrien Report at ¶ 11(f).

[229] Andrien Report at ¶ 106 (emphasis added).

[230] Andrien Report at ¶ 110.

[231] Andrien Report at ¶ 110.

the first type of effect as a "quantity effect" and the second type of effect as a "price effect."[232] In this case, a quantity effect would correspond to an increase in Google's profits resulting from an increase in the number of impressions transacted on AdX as a result of the alleged deception. A price effect would correspond to an increase in Google's profits resulting from higher prices for impressions transacted on AdX due to the alleged deception. In either case, these changes must be linked to the alleged deception (rather than to the program itself).

C. Mr. Andrien Ignores His Own Framework in Calculating DTPA Civil Penalties

105. Mr. Andrien does not follow his own framework for calculating civil penalties. While he acknowledges that, "[i]deally, Google's benefits from the alleged misconduct should be measured as the incremental benefits it obtained by engaging in the misconduct,"[233] he asserts that he was "unable to determine Google's total incremental benefits from the misconduct because Google has not produced information sufficient to determine even the direct benefits from the alleged misconduct, much less the indirect benefits from the alleged misconduct."[234] I show in Section VII that, despite Mr. Andrien's claim, one can in fact use the information produced in this case to assess and quantify Google's incremental benefits from the alleged deception.

106. Rather than follow his own framework, Mr. Andrien arrives at what he asserts to be an "appropriate" penalty by multiplying two inputs, neither of which he calculated in a way that is consistent with the principles he lays out or with any other methodology grounded in economics.[235] The first input is the number of transactions he contends were "affected"

[232] For discussions of the concepts of "quantity effects" (also referred to by economists as "output effects") and "price effects" in other contexts, see, e.g., Mankiw. N. Gregory, Kneebone, Ronald D., and McKenzie, Kenneth J., *Principles of Microeconomics*, 10th Canadian ed. 2017) at 331, 376; Hutchinson, Emma, Principles of Microeconomics, OpenStax CNX, May 18, 2016, at Topic 4.2, available at https://ecampusontario.pressbooks.pub/uvicmicroeconomics/ (last accessed July 25, 2024) ("When you increase price, you increase revenue on units sold (The Price Effect). When you increase price, you sell fewer units (The Quantity Effect).").

[233] Andrien Report at ¶116.

[234] Andrien Report at ¶ 11(f)(ii); see also *id.* at ¶¶ 117-118 ("[T]o date, Google has not produced information relevant and necessary to quantify the direct benefits, much less the indirect benefits from the alleged misconduct."); *id.* at ¶ 110 footnote 285 ("I find these limited documents unreliable and insufficient to support an analysis of the direct benefit of the misconduct to Google.").

[235] Andrien Report at ¶ 76 ("I have been asked to opine on issues related to determining the appropriate amount of the civil penalty in each state.").

by Google's alleged deception.[236] Mr. Andrien does not show that these allegedly "affected" transactions resulted in any gains to Google, but instead simply assumes all transactions were "affected," apparently based on instructions from plaintiffs' counsel.[237] In Section IV, I detail how Mr. Andrien greatly inflated the number of "affected" transactions in numerous ways, including by counting very large numbers of transactions outside the U.S. and transactions that were not actually affected by the alleged deception.

107. The second input into Mr. Andrien's penalty calculation is his asserted per-violation penalty range of [redacted] for each "affected" transaction.[239] Mr. Andrien does not put forth any methodology supporting his conclusion that his proposed range is "appropriate," and he does not ground the range in either economics or his own framework. Mr. Andrien's only explanation for his proposed range of per-violation penalties is that they are "reasonable and appropriate" based on "information available . . . as of today" and his "education, training and experience."[240] Section V discusses in detail why Mr. Andrien's range of per-violation penalties is greatly inflated relative to his own framework.

D. Mr. Andrien Wrongly Bases His Proposed DTPA Civil Penalties on Measures of Revenue Rather Than Incremental Profitability

108. By multiplying his inflated number of "affected" transactions by his inflated and arbitrary per-violation range of penalties, Mr. Andrien calculates the following civil penalties for the alleged DTPA violations:

- RPO: between \$2.06 and \$6.16 billion
- DRS: between \$1.18 and \$3.53 billion
- Bernanke: between \$7.27 and \$21.81 billion

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[236] Andrien Report at ¶ 98 ("I have assumed that Google's misconduct indirectly affected all Open Auctions within the assumed period associated with each misconduct.").

[237] Andrien Report at ¶ 98 footnote 267 ("I have been asked to assume based on Professor Weinberg's report that all auctions during the period in which RPO, DRS v1, DRS v2 and Bernanke misconducts were active were affected by the claimed misconduct whether they were directly affected by the misconduct or not.").

[238] See Andrien Report at Section IV.H.

[239] Andrien Report at ¶¶ 11(h) and 128.

[240] Andrien Report at ¶ 128 ("Based on the information available to me as of today, the analysis presented in this report, as well as my education, training and experience, I conclude that it would be reasonable and appropriate for the trier of fact to assess a penalty in the range of [redacted] for each violation.").

- Equal Footing on AdX: between $4.75 and $14.24 billion; and
- **Total Penalties**: between $7.27 and $21.81 billion.[241]

109. Mr. Andrien claims that he is "unable to determine Google's financial benefit absent the misconduct, and therefore, cannot determine the incremental benefit to it from engaging in the misconduct."[242] Instead, "in lieu of an incremental benefits analysis," he "consider[s] two alternative quantitative measures – Google's display advertising profit and their display advertising revenue" which he contends "provide an indication of the aggregate benefit Google has derived during the period in which it engaged in the [alleged] misconduct."[243] Without explanation, he then dismisses profitability as "an inadequate and inappropriate proxy for the overall benefit, both direct and indirect, that Google has gained from the misconduct" and focuses instead on "Google's display advertising revenue allocable to the plaintiff States."[244] Confirming his focus on revenues, Mr. Andrien asserts that he calculates that Google's gross revenues from its "display advertising segment" during the 2013-2023 period by "isolat[ing] the revenue . . . associated with the display advertising products at issue in this matter" from Google's gross revenues from its DVAA (Display, Video, Apps, and Analytics) business.[245] He calculates that Google's display advertising gross revenue from the plaintiff States [redacted] and concludes that an appropriate total DTPA civil penalty would be up to $21.81 billion.[247]

110. Even though he calculates that Google's display advertising business generated [redacted] of gross revenues[248] and proposes DTPA penalties up to $21.81 billion, Mr.

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[241] Andrien Report at ¶ 11(h), ¶ 127 and Table 4.

[242] Andrien Report at ¶ 118.

[243] Andrien Report at ¶ 118.

[244] Andrien Report at ¶ 123.

[245] Andrien Report at ¶ 92 ("To determine the revenue and profits related to Google's display advertising segment, I rely on internal 'DVAA' profit and loss statements ("P&Ls") as produced by Google. . . . In order to isolate the revenue and profit associated with the display advertising products at issue in this matter, I only include revenue and profits from the P&Ls related to AdSense for Content, AdX, Doubleclick Bid Manager, AdMob, Doubleclick for Publishers, AdServing, Ad Manager, AwBid, Display & Video 360, Campaign Manager, and Google Ads, which I understand are the products at issue in this matter."). Professor Skinner explains that "Mr. Andrien's estimates of booked revenue and operating profit for 2020–2022, reported in Exhibit 2 of his report, would change if I limit his analyses to the at-issue DVAA products, i.e., to Google Ad Manager, Google Ads, and DV360." See Expert Report of Douglas Skinner, July 30, 2024 ("Skinner Report"), at ¶ 50.

[246] See Andrien Report at ¶ 95 and Table 1.

[247] See Andrien Report at ¶ 127 and Table 4, ¶ 130.

[248] See Andrien Report at ¶ 95 and Table 1; see also *id.* at ¶ 119.

Andrien does not articulate a methodology to connect those two amounts. He also makes numerous errors in calculating those amounts, causing them both to be greatly exaggerated.

111. Mr. Andrien's proposed $21.81 billion penalty is grossly inflated because he uses greatly exaggerated transaction counts and multiplies these by an overstated [redacted] penalty. The most significant cause of Mr. Andrien's gross inflation of transaction counts, which I discuss further in Section IV below, is his inclusion of worldwide AdX transactions rather than limiting his counts to U.S. transactions. I show below that limiting transactions to those involving U.S. users (but not accounting for other errors discussed in Section IV) reduces total transaction counts from [redacted][249] Adjusting Mr. Andrien's proposed penalty amount for this one error reduces his upper range penalty estimate from $21.81 billion to $4.1 billion.[250]

112. Mr. Andrien's calculation of $[redacted] in display advertising gross revenue is also greatly exaggerated because it includes revenues attributable to products that plaintiffs do not allege are at issue in this case, including AdMob, AdSense for Content, and Campaign Manager.[251] Based on the data provided in Mr. Andrien's backup materials, I estimate that these three products were responsible for about [redacted] percent of Google's display advertising gross revenues in 2022.[252]

113. Furthermore, Mr. Andrien's display advertising gross revenue figure includes DV360's revenues resulting from transactions on third-party exchanges which are not at issue and

[249] Calculations based on workpaper "DTPA Transaction Count Tables.xlsx". Additional calculations pertaining to transaction counts or estimates in this section are also based on the same workpaper.

[250] The reduced penalty of $4.1 billion is calculated as [redacted] transactions times Mr. Andrien's upper per-unit penalty of $[redacted].

[251] Andrien Report at ¶ 92 ("To determine the revenue and profits related to Google's display advertising segment, I rely on internal "DVAA" profit and loss statements ("P&Ls") as produced by Google. . . . In order to isolate the revenue and profit associated with the display advertising products at issue in this matter, I only include revenue and profits from the P&Ls related to AdSense for Content, AdX, Doubleclick Bid Manager, AdMob, Doubleclick for Publishers, AdServing, Ad Manager, AwBid, Display & Video 360, Campaign Manager, and Google Ads, which I understand are the products at issue in this matter."). Professor Skinner explains that ("Mr. Andrien's estimates of booked revenue and operating profit for 2020–2022, reported in Exhibit 2 of his report, would change if I limit his analyses to the at-issue DVAA products, i.e., to Google Ad Manager, Google Ads, and DV360." Skinner Report at ¶ 50.

[252] Calculations based on Andrien Report Exhibit 2 and Andrien backup materials. See workpaper "AdMob, AdSense, CM Share of Google Display Advertising (Andrien Exhibit 2).xlsx".

which Mr. Andrien excludes from his count of violations.[253] Using data produced by Google in this case, I estimate that over the 2013-2023 period about [redacted] percent of DV360 ad spend on U.S. Open Auction transactions occurred on third-party exchanges.[254] Similarly, Mr. Andrien's display advertising gross revenue figure includes Google Ads' revenues resulting from transactions on third-party exchanges. Using data produced by Google in this case, I estimate that over the 2013-2023 period about [redacted] percent of Google Ads' ad spend on U.S. Open Auction transactions occurred on third-party exchanges.[255]

114. Holding these fundamental errors aside, Google's gross revenues are not a proper basis for calculating the benefits to Google from the alleged deception. First, Mr. Andrien admits that Google pays [redacted] percent of its gross revenues to publishers as Traffic Acquisition Costs (TAC).[256] Any attempt to calculate benefits to Google should, at minimum, deduct TAC from gross revenues because Google does not retain any benefit from that portion of its gross revenues – it passes all of it along to publishers.

115. Second, even net revenues [redacted] are not an appropriate measure of how much Google benefits from its allegedly deceptive conduct. Economists focus on profits as the correct measure of benefits to a firm because revenues do not take into account that revenue generation requires the expenditure of costs. Indeed, economists generally assume that firms maximize profits because profits measure the net benefit created by a firm for its owners.[257]

116. Mr. Andrien calculates that Google's display advertising business earned [redacted] in

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[253] Mr. Andrien's starting dataset is Google's AdX data, and he only uses Open Auction transactions on Google's AdX in his analysis. See Mr. Andrien's backup codes [redacted]"

[254] These calculations are based on DV360 data through March 2023 and are described in Appendix H. See workpaper "DV360 and GA Share of Spend on 3PE."

[255] The percentage of Google Ads' ad spend going to third-party exchanges has [redacted] from about [redacted] percent in 2015 to about [redacted] percent in 2017 and to about [redacted] percent in 2022. These calculations are based on Google Ads data described in Appendix H. See workpaper "DV360 and GA Share of Spend on 3PE."

[256] Andrien Report at ¶ 120. ("One Google document shows that in 2018 TAC was estimated to account for [redacted]% of display gross revenue and notes that 'margin structure is [redacted].'"). See also Andrien Report at Exhibit 2.

[257] See, e.g., Mankiw, N. Gregory, *Macroeconomics*, Worth Publishers, 7th ed. 2009, at 50-51 ("The goal of the firm is to maximize profit. Profit is equal to revenue minus costs; it is what the owners of the firm keep after paying for the costs of production.").

operating profit associated with the plaintiff States between 2013 and 2023,[258] but that amount is not an appropriate measure of Google's gains from the alleged DTPA violations. Like Google's display advertising gross revenues, Google's display advertising operating profits include results for products unrelated to the claims in this case,[259] and from transactions achieved by Google's ad buying tools via third-party exchanges. After correcting these errors, I estimated the operating profit generated by Google's display advertising business between January 2013 and December 2023 from Open Auction transactions in the plaintiff States [redacted].[260]

117. Even more fundamentally, using Mr. Andrien's measure [redacted] in display advertising operating profits as a benchmark for DTPA civil penalties would overstate the relevant measure under Mr. Andrien's framework. According to Mr. Andrien, penalties should be limited to the *incremental* benefits Google received *from the alleged deception.*[261] Mr. Andrien does not claim that

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[258] Andrien Report at ¶ 95 and Table 1. Operating profit is an accounting measure of profit, defined as "the total income a company generates from sales after paying off all operating expenses, such as rent, employee payroll, equipment and inventory costs. The operating profit figure excludes gains or losses from interest, taxes and investments." See "What is Operating Profit? Everything You Need to Know," *American Express*, May 22, 2024, available at https://www.americanexpress.com/en-gb/business/trends-and-insights/articles/what-is-operating-profit/ (last accessed July 27, 2024).

[259] Mr. Andrien drew Google's display advertising gross revenue and operating profit data from Google's DVAA profit and loss ("P&L") statements. He asserts that "[t]o determine the revenue and profits related to Google's display advertising segment, I rely on internal "DVAA" profit and loss statements ("P&Ls") as produced by Google. . . . In order to isolate the revenue and profit associated with the display advertising products at issue in this matter, I only include revenue and profits from the P&Ls related to AdSense for Content, AdX, Doubleclick Bid Manager, AdMob, Doubleclick for Publishers, AdServing, Ad Manager, AwBid, Display & Video 360, Campaign Manager, and Google Ads, which I understand are the products at issue in this matter." Andrien Report at ¶ 92. Consequently, the DVAA P&L statements relied upon by Mr. Andrien reflect the financial performance of not only the Google products at issue in this matter – Google Ad Manager, Google Ads, and DV360 – but also of AdMob, AdSense for Content, and CM360 (otherwise known as Campaign Manager). Professor Skinner explains that "Mr. Andrien's estimates of booked revenue and operating profit for 2020–2022, reported in Exhibit 2 of his report, would change if I limit his analyses to the at-issue DVAA products, i.e., to Google Ad Manager, Google Ads, and DV360." Skinner Report at ¶ 50.

[260] Calculations available in workpaper "Profit from Open Auction Transactions.xlsx." In calculating the [redacted] figure, I allocated operating profit for the U.S to plaintiff States using Mr. Andrien's methodology (described further in Section IV.D), which is based on their share of internet subscribers. I also allocated operating profits based on the billing address of advertisers, which reduced my estimate of the operating profit generated by Google's display advertising business between January 2013 and December 2023 from Open Auction transactions in the plaintiff States [redacted].

[261] Andrien Report at ¶ 11(f) ("To deter Google from continuing its misconduct, the penalty must eliminate Google's financial incentive to engage in the misconduct. At minimum, this would involve penalizing Google for the total incremental benefits (including future benefits) from the alleged misconduct."); *id.* at ¶ 106 ("From a financial and economic perspective, to deter future violations, the total penalty must eliminate Google's financial incentive to

all of Google's display advertising operating profits (or revenues) arose as a result of the alleged deception, and it is implausible that the alleged deception would account for all of those profits (or revenues). In Section VII, I calculate how much incremental profit Google generated from the alleged deception and find that it is indeed only a small fraction [redacted] in total display advertising operating profits calculated by Mr. Andrien.

IV. Mr. Andrien Inflates Transaction Counts Due to Numerous Errors

118. As noted in Section III, the first critical misstep in Mr. Andrien's ad hoc penalty analysis concerns his assumption regarding the number of transactions allegedly "affected" by Google's misconduct. In response to an apparent instruction from plaintiffs' counsel, he simply and incorrectly assumes that all Open Auction[262] transactions were affected.[263] As discussed below, there are numerous errors that inflate Mr. Andrien's count of "affected" transactions. Correcting for those errors (individually and in combination) results in a much smaller number of affected transactions. [264]

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engage in the alleged misconduct.… One way to frame the appropriate amount to deter future bad behavior is to consider an approach that penalizes Google for at least the benefits it gained associated with the alleged misconduct.").

[262] Mr. Andrien creates the data for his calculations in programs [redacted]

[263] See Andrien Report at ¶ 98 (indicating that he "assumed that Google's misconduct indirectly affected all Open Auctions within the assumed period associated with each misconduct"); *id.* at ¶ 98 footnote 267 (indicating that Mr. Andrien had "been asked to assume based on Professor Weinberg's report that all auctions during the period in which RPO, DRSv1, DRSv2, and Bernanke misconducts were active were affected by the claimed misconduct, whether they were directly targeted by the misconduct or not."). Mr. Andrien fails to account for the fact that, under plaintiffs' theory, the alleged deception would have affected incentives for only certain auction participants. Below, I carefully determine which auctions would have been affected (under plaintiffs' theory) and find that many auctions would not have been affected.

[264] Mr. Andrien does not provide a justification of why a count of matched queries is the correct measure of transactions. A possible alternative would be to count viewed impressions as transactions. Basing transaction counts on viewed impressions would reduce those counts by about [redacted], relative to counts based on matched queries (for sources and calculations, see workpaper [redacted] Another possible alternative would be to base the number of transaction counts on the number of advertisers and/or publishers affected by the alleged deception, rather than the number of affected transactions. Between November 2013 (the date when Bernanke was introduced) and October 2021 (the date when the allegations in this case were largely unsealed, revealing the alleged deception, see Second Amended Complaint, *In re Google Digital Advertising Litig*., 1:21-md-03010-PKC (S.D.N.Y. Oct. 22, 2021), ECF No. 152), I estimate that [redacted] advertisers and [redacted] publishers participated in AdX Open Auction transactions involving U.S. users during that period. See workpaper "DTPA Transaction Count Tables.xlsx." Despite these alternatives, I adopt Mr. Andrien's approach of using matched queries to count alleged violations,

119. Table 1 summarizes my analysis of Mr. Andrien's errors in counting the number of transactions affected by Google's alleged deception. The table focuses on total counts of "de-duplicated" alleged violations, across all programs considered in Mr. Andrien's analysis. De-duplication adopts Mr. Andrien's approach of counting each transaction at most one time (even when potentially affected by multiple alleged deceptions).[265] The first row of Table 1 shows that Mr. Andrien claims that [redacted] transactions were impacted by the alleged deception.[266] The remaining rows show the effect on transaction counts of correcting each of Mr. Andrien's errors, either one at a time (columns 1 and 2) or cumulatively (i.e., sequentially adding the impact of more corrections, shown in columns 3 and 4). I discuss below how each of Mr. Andrien's errors inflates his count of the total number of affected transactions.[267] Table C1 in Appendix C reports the number of affected transactions separately for each program.

without accepting that is the correct starting place.

[265] See Andrien Report at ¶ 127 and Table 4. This approach means that if a transaction was "affected" by two or more programs, it would be counted a single time for the purpose of computing total civil penalties. See *id.* at ¶ 101 ("While I provide a violation count of Open Auctions associated with each misconduct in this table, each individual auction should only be counted as one violation. For example, if the trier of fact finds that Google is liable for both RPO and Bernanke, each auction that occurred during the period both misconducts were active should only be counted once as a violation.").

[266] See Andrien Report at ¶¶ 98-101 and Table 2 (indicating [redacted] alleged violations involving Bernanke, which, because Mr. Andrien de-duplicates transactions, equals Mr. Andrien's total transaction count).

[267] Calculations described in this section regarding are based on workpaper "DTPA Transaction Count Tables.xlsx."

[redacted]

Sources: Data for AdX, Google Ads, and DV360 (see Appendix H for Bates numbers); XPP Data (GOOG-AT-MDL-DATA-000559277 to GOOG-AT-MDL-DATA-000561030); Billing State Crosswalk Data (GOOG-AT-EDTX-DATA-001116101, GOOG-AT-EDTX-DATA-001116100, GOOG-AT-EDTX-DATA-001116099); Autobidding Data (GOOG-AT-DOJ-DATA-000011657 to GOOG-AT-DOJ-DATA-000012656).

A. Mr. Andrien Incorrectly Includes Transactions Associated with Users Outside of the United States

120. Mr. Andrien states that his count of [redacted] violations is limited to "web display

transactions . . . involving U.S. users."[268] However, while the data he uses do allow for the isolation of transactions involving U.S. users, Mr. Andrien's counts are not limited to transactions involving U.S. users. Instead, he uses counts of worldwide transactions.[269]

121. Correcting this error reduces Mr. Andrien's de-duplicated transaction count from [redacted] to [redacted], an [redacted] percent decrease.[270]

B. Mr. Andrien Incorrectly Includes In-App Transactions

122. As noted above, Mr. Andrien explains that "[i]n order to count violations, I use data as provided by Google on 'web display transactions . . . involving U.S. users.'"[271]

123. My review of Mr. Andrien's programming code reveals that, while the data he uses do allow for the exclusion of in-app transactions, he does not in fact exclude in-app transactions.[272] As a result, despite his stated method of counting only alleged violations for Open Auction web transactions, Mr. Andrien includes in-app transactions as well.

124. Excluding in-app transactions further reduces Mr. Andrien's de-duplicated transaction count to [redacted], an [redacted] percent cumulative reduction relative to his total count of [redacted] transactions.[273]

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[268] Andrien Report at ¶ 97.

[269] Mr. Andrien creates the data for his calculations in programs [redacted] As a result, Mr. Andrien's analysis includes both transactions involving U.S. users and transactions involving users in other countries.

[270] [redacted]

[271] Andrien Report at ¶ 97; see also *id.* at ¶ 55 ("The Plaintiff States allege that Google engaged in unfair, false, deceptive, and misleading business practices related to their display advertising technology and changes it made to the auctions for web display ads during the period of at least 2013 to the present.").

[272] Mr. Andrien creates the data for his calculations in programs [redacted] As a result, Mr. Andrien's analysis includes both web transactions and in-app transactions.

[273] [redacted]

C. Mr. Andrien Incorrectly Includes States that Cannot Recover Civil Penalties for Business-to-Business Transactions

125. Plaintiffs' claims and Mr. Andrien's data and analysis concern only business-to-business transactions between Google and its advertiser or publisher customers.[274] I understand that the deceptive trade practices acts of Arkansas, Idaho, Indiana, and Utah apply only to consumer transactions.[275] It follows that Mr. Andrien's transaction counts should not include transactions associated with those four states. Excluding those four states further reduces Mr. Andrien's de-duplicated transaction count to [redacted], which represents an [redacted] percent cumulative reduction relative to his total count of [redacted] transactions.[276]

D. Mr. Andrien Incorrectly Allocates Transaction Counts to Plaintiff States by Failing to Use Available Data About Advertiser Locations

126. Mr. Andrien allocates his overall transaction counts to the 17 plaintiff States on the basis of internet-subscriber data drawn from the U.S. Census Bureau's American Community Survey. He begins by estimating the number of internet subscribers in all of the plaintiff States.[277] He next divides the number of internet subscribers in those states by the total number of internet subscribers in the U.S. as a whole and then multiplies that ratio (about 29 percent on average between 2013 and 2023) by his count of U.S. transactions to estimate a count of transactions associated with all of the plaintiff States.[278]

127. Mr. Andrien apparently recognizes that a more accurate allocation method would use the

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[274] See, e.g., Andrien Report at ¶ 29 ("I understand that, starting at least as early as 2010 and running through September 2019, Google represented to both *publishers and advertisers* that AdX was operated as a second-price auction.… Further, I understand that Google made misrepresentations and concealed important information related to this conduct, even concealing some of these programs entirely, thus misleading and deceiving *auction participants* and causing them to behave differently than they would have but for Google's misconduct." (emphasis added)). See also FAC at ¶ 526 ("Google failed to properly disclose these programs (or disclose them at all) and misled publishers and advertisers about their existence and effects.").

[275] See Google LLC's Motion to Dismiss Pursuant to Rule 12(b)(6) at 25-26, *State of Texas, et al. v. Google LLC*, No. 4:20-cv-00957-SDJ (E.D. Tex. Feb. 8, 2024), ECF No. 224 ("Plaintiffs' allegations relate to transactions with publishers and advertisers, and not to consumer transactions. Arkansas, Idaho, Indiana, and Utah therefore fail to state claims under their DTPAs, and those claims should be dismissed.").

[276] [redacted]

[277] Andrien Report at ¶ 94.

[278] Andrien Report at ¶ 94.

locations of advertisers and publishers (rather than internet subscriber statistics),[279] but he fails to use the data on the billing state of advertisers and publishers that Google has produced.[280]

128. I use these data to estimate each U.S state's percentage of U.S. impressions, [281] based on the billing address of advertisers and publishers.[282] I estimate that about [redacted] percent of U.S. transactions are associated with the plaintiff States based on the billing address of advertisers.[283] Adjusting the number of U.S. transactions by [redacted] percent (rather than Mr. Andrien's [redacted] percent) further reduces Mr. Andrien's de-duplicated count of transactions to [redacted], a [redacted] cumulative decrease relative to his total count of [redacted] transactions.[284]

E. Mr. Andrien Incorrectly Assumes that the Alleged Deception Persisted Longer Than It Did

129. Mr. Andrien's counts assume that transactions were affected by the alleged deception until May 2024.[285] But the conduct on which plaintiffs' deception claims are based was disclosed before May 2024, and under their theory, the alleged deception could not have

[279] Mr. Andrien states, "Based on Google's verified discovery responses, Google has not identified the state of residence, organization or incorporation of any of its customers and has not otherwise produced, among other relevant requested data, revenue and profit specific to the plaintiff States in this matter. Based on the information currently available at this time, I have estimated the share of Google's display advertising revenue and profit associated with the plaintiff States using the below described methodology." Andrien Report at ¶ 91.

[280] Although Mr. Andrien relies on Google's April 8, 2024 interrogatory responses, Google supplemented those responses on May 3, 2024 to explain that "Google has identified ordinary-course sources of current information on customer billing state … which can be mapped to customer identifiers in the above-mentioned datasets, and has generated 'crosswalks' between these datasets and billing state sources." See Defendant Google LLC's Supplemental Response to Plaintiffs' Second Set of Interrogatories, May 3, 2024, at 4; see also GOOG-AT-EDTX-DATA-001116100; GOOG-AT-EDTX-DATA-001116099.

[281] Similar, but slightly smaller, state allocation shares result if I use gross revenue instead than impressions. Calculations included in workpaper "Allocation_Shares.xlsx."

[282] Some advertisers and publishers are assigned to multiple billing states. In these situations, I use Mr. Andrien's state internet subscriber estimates to allocate the relevant impressions to individual states. For example, the data may indicate that an advertiser's billing states are New York, Texas, and Florida. I assign a share of the advertisers' impressions to each state equal to the percentage of internet subscribers in that state (calculated as the number of internet subscribers in that state divided by the total number of internet subscribers in all billing states associated with the advertiser).

[283] [redacted]

[284] [redacted]

[285] See Andrien Report at ¶ 99 and Table 2.

affected transactions after the underlying conduct was disclosed.

a. *Reserve Price Optimization*

130. To estimate the number of transactions affected by the alleged deception about RPO, Mr. Andrien counts transactions occurring between the months when RPO launched (April 2015) and when Google introduced the unified first price auction (September 2019).[286] Mr. Andrien disregards that the alleged deception about RPO ended in May 2016, when Google publicly disclosed that it had introduced a program that "uses historical data to automate the post-auction analysis and updating of floor prices that publishers already do, and takes it a step further."[287] Implementing this correction—and counting only transactions from April 2015 to May 2016 as potentially impacted by the alleged deception about RPO—reduces the number of relevant transactions associated with the alleged RPO-related deception from [redacted] to [redacted], a reduction of [redacted] percent.[288]

b. *DRS v1*

131. Mr. Andrien and I assume that only transactions from August 2015 to November 2016[289]

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[286] See Andrien Report, at ¶ 127 and Table 4 (indicating that the RPO penalty period started on 3/31/2015 and ended on 9/25/2019 and explaining that when "[the beginning of the penalty period] is after the first day of the month, violation count starts on the first day of the following month; if [the end of the penalty period] is after the first day of the month, violation count ends on the last day of the previous month"); see also Defendant Google LLC's First Amended Responses and Objections to Plaintiffs' Third Set of Interrogatories, Responses to Interrogatory No. 6 at 12 (reporting that "Reserve Price Optimization launched on or about March 31, 2015. RPO v.2 subsequently launched on or about October 5, 2015. Prior versions of RPO were disabled along with the Google Ad Manager switch to first-price auctions in September-October 2019. In June 2022, Google launched a version of RPO designed for Ad Manager's first-price auction, known as Optimized Pricing, on select web traffic, and it was extended to all web traffic in January 2023.").

[287] See Bellack, Jonathan, "Smarter optimizations to support a healthier programmatic market," *Google Ad Manager Blog*, May 12, 2016, available at https://blog.google/products/admanager/smarter-optimizations-to-suppor/ (last accessed July 26, 2024); GOOG-AT-MDL-C-000015606 at -611.

[288] [redacted]

[289] This range is conservative because Google disclosed DRS v1 on August 4, 2015, prior to the full launch of DRS v1 on August 20, 2015. See GOOG-AT-MDL-C-000035251 at -251 (Google Help Center post with filename of "web_152039_version_47_*2015-08-04*__11_33_52.pdf", explaining that "[t]he Ad Exchange auction closing price is determined as the greater of the second-highest net bid in the Ad Exchange auction or the reserve price applied to that impression. *In some cases, the auction may close at a price lower than the reserve price applied, due to auction optimizations*. Sellers are paid the Ad Exchange closing price, *net of Google's revenue share*, but will receive, subject to the terms governing their use of Ad Exchange, no less than the min CPM applied to the auction." (emphases

would potentially be affected by the alleged deception about DRS v1.[290]

c. DRS v2

132. To estimate the number of transactions affected by the alleged deception about DRS v2, Mr. Andrien counts transactions occurring between the months when DRS v2 launched (December 2016) and when it was replaced by truthful DRS (July 2018).[291] Mr. Andrien disregards that, in June 2016 (i.e., roughly six months before it introduced DRS v2), Google publicly disclosed that it "may increase or decrease revenue share per query. If you'd prefer to apply your contracted revenue share on every query, use the new Ad Exchange UI Admin control to exclude all the sites you monetize through your account from revenue share-based optimizations."[292] As a result, there was no period of time during which transactions were impacted by any alleged deception related to DRS v2.[293]

added)); Defendant Google LLC's First Amended Responses and Objections to Plaintiffs' Third Set of Interrogatories, Responses to Interrogatory No. 6 ("Dynamic Revenue Share launched on or about August 20, 2015.").

[290] Bidders were likely to detect DRS v1 even if it had not been disclosed. In particular, with DRS v1, a bidder submitting a bid in the "dynamic region" (i.e., between the publisher set price floor and the amount that an advertiser would need to bid to clear that price floor, after accounting for AdX's revenue share) would sometimes win an impression that, in absence of DRS v1, it could not win and it would pay its bid for such an impression. Therefore, detecting DRS does not require a high level of sophistication or monitoring: a bidder could simply observe that it was winning impressions that it should not have been able to win.

[291] See Andrien Report Exhibit 5 (indicating that DRS v2 started on 12/1/2016 and ended on 7/17/2018 and explaining that when "[the beginning of the penalty period] is after the first day of the month, violation count starts on the first day of the following month; if [the end of the penalty period] is after the first day of the month, violation count ends on the last day of the previous month"); see also Defendant Google LLC's First Amended Responses and Objections to Plaintiffs' Third Set of Interrogatories, Responses to Interrogatory No. 6, at 12 (indicating that "Dynamic Revenue Share launched on or about August 20, 2015. DRS v. 2 subsequently launched on or about December 1, 2016. tDRS subsequently launched on or about July 17, 2018.").

[292] See "2016 releases archive: DoubleClick for Publishers and Ad Exchange Seller," *Google Ad Manager Help*, available at https://support.google.com/admanager/answer/7421657?sjid=10086602547051235141-NA#zippy=%2Cjune-change-history-update-safeframe-for-creative-types-deal-check-bid-filter-apply-per-query-revenue-share-optimization (last accessed July 25, 2024) (providing a Q2 2016 Ad Exchange release stating "New Ad Exchange control for applying per-query revenue share optimization"); GOOG-AT-MDL-C-000015769 at -779. See also Weinberg Report at ¶¶ 197 (explaining that "Google announced DRSv2 when it was launched," but arguing that "if the concept of debt was not clearly disclosed, the general description of DRS as per-query revenue share optimization is insufficient for advertisers to draw conclusions at the level I have drawn in my report."); Andrien Report at ¶ 39 ("Google announced DRSv2 (under a different name) when it was launched and allowed publishers to opt out of the program (if a publisher opted out, DRSv1 was turned off as well), but advertisers and ad buying tools could not.").

[293] See Table C1 in Appendix C.

d. Project Bernanke

133. Mr. Andrien and I assume that only transactions occurring between the months when Bernanke launched (November 2013) and when Alchemist replaced second-price Bernanke (October 2019) would potentially be affected by the alleged deception about the versions of Bernanke that were designed for second-price auctions.[294]

e. Alchemist

134. To estimate the number of transactions affected by the alleged deception about Alchemist (also known as first-price Bernanke), Mr. Andrien counts transactions occurring between the first full month when Google ran a unified first price auction (October 2019) and May 2024.[295] In doing so, Mr. Andrien disregards that the complaint in this litigation was largely unsealed in October 2021, and the unsealed complaint publicly revealed, that "Bernanke effectively manipulates" an advertiser's bid "without [the advertiser's] knowledge (or anyone's knowledge) before routing it to Google's exchange."[296] Recognizing that disclosure and counting only transactions from October 2019 through

[294] See Andrien Report Exhibit 5 (indicating that "Second-Price Bernanke" started on 11/11/2013 and ended on 10/25/2019 and explaining that when "[the beginning of the penalty period] is after the first day of the month, violation count starts on the first day of the following month; if [the end of the penalty period] is after the first day of the month, violation count ends on the last day of the previous month"); see also Defendant Google LLC's First Amended Responses and Objections to Plaintiffs' Third Set of Interrogatories, Responses to Interrogatory No. 6 at 12 ("Project Bernanke launched on or about November 11, 2013. Subsequent versions of Bernanke include Global Bernanke, which launched on or about August 12, 2015; Project Bell v.2, which launched on or about October 26, 2016; and a further version of Bernanke compatible with Ad Manager's first-price auction (sometimes known as 'Alchemist'), which launched no later than on or about October 25, 2019.").

[295] See Andrien Report Exhibit 5 (indicating that "First-Price Bernanke" started on 10/25/2019 and continued to the "present" and explaining that when "[the beginning of the penalty period] is after the first day of the month, violation count starts on the first day of the following month; if [the end of the penalty period] is after the first day of the month, violation count ends on the last day of the previous month"); *id.* Exhibit 3 ("Auction counts are extended through the end of May 2024 assuming that the count of auctions in each month for the period April 2023 to May 2024 is equal to the average count of auctions during the first three months of 2023."); see also Defendant Google LLC's First Amended Responses and Objections to Plaintiffs' Third Set of Interrogatories, Responses to Interrogatory No. 6 at 12 (reporting a "further version of Bernanke compatible with Ad Manager's first-price auction (sometimes known as 'Alchemist'), which launched no later than on or about October 25, 2019").

[296] See Second Amended Complaint ¶¶ 151-153, *State of Texas, et al. v. Google LLC,* No. 1:21-md-03010-PKC (S.D.N.Y. Oct. 22, 2021), ECF No. 152. Bernanke was also discussed in a The Wall Street Journal article from April 2021 (Horwitz, Jeff and Keach Hagey, "Google's Secret 'Project Bernanke' Revealed in Texas Antitrust Case," *The Wall Street Journal*, April 11, 2021, available at https://www.wsj.com/articles/googles-secret-project-bernanke-revealed-in-texas-antitrust-case-11618097760 (last accessed July 25, 2024)) and in an Ad Exchanger article from January 2022 (Schiff, Allison, "More Details Revealed On Project Bernanke And Jedi Blue In Newly Unsealed Google Suit," *AdExchanger*, January 14, 2022, available at https://www.adexchanger.com/online-advertising/more-details-revealed-on-project-bernanke-and-jedi-blue-in-newly-unsealed-google-suit/ (last accessed July 25, 2024)).

October 2021 as potentially impacted by the alleged deception about Alchemist reduces the number of potentially affected transactions from [redacted] to [redacted], a reduction of [redacted] percent.[297]

f. Equal Footing

135. To estimate the number of transactions affected by the alleged "Equal Footing" deception, Mr. Andrien counts transactions occurring between the month when Google announced that all bidders in the unified first price auction would be treated equally (November 2019) and May 2024.[298] In doing so, Mr. Andrien disregards that Alchemist and the Facebook Network Bidding Agreement (NBA) were publicly disclosed when the complaint for this litigation was largely unsealed in October 2021 and that industry participants were therefore on notice of both forms of Bernanke and the Facebook NBA as of that point in time.[299] Recognizing that disclosure and counting only transactions from October 2019 through October 2021 as potentially impacted by the alleged deception about Alchemist and the NBA reduces the number of potentially affected transactions [redacted]

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[297] [redacted]

[298] See Andrien Report at ¶ 99 ("For Equal Footing/AdX Fairness, I use November 20, 2019 as the starting date, which is the date of the earliest identified widespread representation by Google regarding auction participants competing equally, though as stated above, Google made such representations before that time."); *id.* Exhibit 4 (assuming that the equal footing violation is ongoing, listing "Period End" as "Present"); *id.* Exhibit 3 ("Auction counts are extended through the end of May 2024 assuming that the count of auctions in each month for the period April 2023 to May 2024 is equal to the average count of auctions during the first three months of 2023.").

[299] See Second Amended Complaint ¶¶ 151-153, 203-234, *In re Google Digital Advertising Litig.*, No. 1:21-md-03010-PKC (S.D.N.Y. Oct. 22, 2021), ECF No. 152. The NBA was also discussed in a The Wall Street Journal article from April 2021 (Horwitz, Jeff, and Keach Hagey, "Google's Secret 'Project Bernanke' Revealed in Texas Antitrust Case," *The Wall Street Journal*, April 11, 2021, available at https://www.wsj.com/articles/googles-secret-project-bernanke-revealed-in-texas-antitrust-case-11618097760 (last accessed July 25, 2024), and in an Ad Exchanger article from October 2021 reporting that "[t]he unsealed suit also contains more detail on Jedi Blue, the codename for Google's alleged agreement to charge Facebook lower fees and give Facebook information, speed and other advantages in header bidding auctions in exchange for Facebook's support of Open Bidding, Google's header bidding alternative." Schiff, Allison, "Dominance And Collusion: Inside The Unredacted Antitrust Lawsuit Against Google's Ad Tech Business," *AdExchanger*, October 25, 2021, available at https://www.adexchanger.com/platforms/dominance-and-collusion-inside-the-unredacted-antitrust-lawsuit-against-googles-ad-tech-business/ (last accessed July 25, 2024); see also Lyden, Carolyn, "Google allegedly creates ad monopoly with Facebook to favor its own exchange according to new, unredacted details from Project Jedi," *Search Engine Land*, October 25, 2021 available at https://searchengineland.com/google-allegedly-creates-ad-monopoly-with-facebook-to-favor-its-own-exchange-according-to-new-unredacted-details-from-project-jedi-375487 (last accessed July 25, 2024).

[redacted][300]

136. Accounting for all of the disclosures discussed above further reduces Mr. Andrien's de-duplicated count of transactions to [redacted], a [redacted] percent cumulative decrease relative to his total count of [redacted] transactions.[301]

F. Mr. Andrien Does Not Account for Statutes of Limitations

137. I understand that many of the plaintiff States' respective statutes of limitations define intervals of time following disclosures during which DTPA violations can be alleged and penalties claimed. Mr. Andrien's transaction counts do not take account of these statutes of limitations.

138. Counsel for Google has provided me information on each plaintiff State's "critical date," which is the date corresponding to the number of years prior to the filing date of plaintiff States' original complaint (December 16, 2020) that is equal to the length of that state's statute of limitations for DTPA claims. If a program was disclosed before the critical date applicable to a plaintiff State, I conclude that the state cannot recover DTPA civil penalties for the alleged deception about that program (i.e., for the purpose of calculating DTPA civil penalties for that state, the number of transactions affected by that alleged deception is zero). Appendix E provides more details about how I account for statutes of limitations in my analysis.

139. Google disclosed RPO in May 2016[302] and DRS in June 2016.[303] I understand that Florida, Idaho, Nevada, Puerto Rico, and South Dakota cannot recover DTPA civil penalties if a program was disclosed before December 16, 2016; that Missouri and South Carolina cannot recover DTPA civil penalties if a program was disclosed before December 16,

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300 [redacted]

301 [redacted]

302 See Bellack, Jonathan, "Smarter optimizations to support a healthier programmatic market," *Google Ad Manager Blog*, May 12, 2016, available at https://blog.google/products/admanager/smarter-optimizations-to-suppor/ (last accessed, July 26, 2024); GOOG-AT-MDL-C-000015606 at -611-612.

303 See "2016 releases archive: DoubleClick for Publishers and Ad Exchange Seller," *Google Ad Manager Help*, June 13, 2016, available at https://support.google.com/admanager/answer/7421657?sjid=10086602547051235141-NA#zippy=%2Cjune-change-history-update-safeframe-for-creative-types-deal-check-bid-filter-apply-per-query-revenue-share-optimization. (last accessed July 25, 2024) (under the Q2 2016 Ad Exchange release stating "New Ad Exchange control for applying per-query revenue share optimization"); GOOG-AT-MDL-C-000015769.

2017; and that Indiana, Kentucky, Montana, and North Dakota cannot recover DTPA civil penalties if a program was disclosed before December 16, 2018.[304] Because RPO and DRS were disclosed before all of these critical dates, I understand that the plaintiff States of Florida, Idaho, Indiana, Kentucky, Missouri, Montana, Nevada, North Dakota, Puerto Rico, South Carolina, and South Dakota cannot recover DTPA civil penalties for alleged deception concerning RPO and DRS. For this reason, applying these states' statutes of limitations would reduce the number of transactions potentially impacted by the alleged deception about RPO by [redacted] percent and the number of transactions potentially impacted by the alleged deception about DRS by [redacted].[305]

140. Because the alleged deception concerning Bernanke/Alchemist has the earliest start date (November 2013) and ended in October 2021 (i.e., before the statute of limitations expired for any plaintiff State), state statutes of limitations do not change my corrected version of Mr. Andrien's de-duplicated count of potentially impacted transactions by the alleged deception. I note, however, that if Google is not found liable for DTPA violations related to Bernanke/Alchemist, then the statutes of limitations would lead to a reduction in the de-duplicated number of transactions across the other allegedly deceptive programs.

G. Mr. Andrien Incorrectly Includes Unaffected Transactions

141. Mr. Andrien, at the apparent request of plaintiffs' counsel, assumes that all Open Auction transactions occurring during the penalty period for a program were "affected" by the alleged deception about that program.[306] Mr. Andrien makes no attempt to link these allegedly "affected" transactions to any gains to Google from the alleged deception.

142. Mr. Andrien includes in his transaction counts some transactions that *could not have been affected by the alleged deception*, even according to the theory laid out by Professor Weinberg, on whom Mr. Andrien relies. In this section, I estimate how many transactions

[304] See Appendix E.

[305] [redacted]

[306] Andrien Report at ¶ 98 ("I have assumed that Google's misconduct indirectly affected all Open Auctions within the assumed period associated with each misconduct."); *id.* at ¶ 98, footnote 267 ("I have been asked to assume based on Professor Weinberg's report that all auctions during the period in which RPO, DRSv1, DRSv2, and Bernanke misconducts were active were affected by the claimed misconduct, whether they were directly targeted by the misconduct or not.").

should have been excluded from Mr. Andrien's transaction counts because, under the plaintiffs' theory, the alleged deception could not have affected (i) the clearing price, (ii) the winning bidder, (iii) whether the transaction cleared on AdX, or (iv) AdX's revenue share. These exclusions are conservative because neither Mr. Andrien nor Professor Weinberg has provided any data or empirical evidence to identify any transactions that would be affected by the alleged deception or to indicate that the remaining transactions *actually were* affected by the alleged deception.[307]

143. Excluding transactions that could not have been affected further reduces the total count of transactions from [redacted] to [redacted], as shown in row 7 of Table 1. This represents a [redacted] percent reduction relative to the count of transactions remaining after accounting for Mr. Andrien's other errors (described above).[308] When taken together with the corrections described in the previous subsections, removing unaffected transactions reduces Mr. Andrien's count of affected transactions from [redacted] to [redacted], which is a [redacted] cumulative reduction.[309]

144. Below, I describe the details of how I estimate the number of transactions affected by the alleged deception about each program.[310] The starting point for each calculation is the transaction count after making the corrections described in the previous subsections (i.e., the counts in row 6 of Table C1 in Appendix C). That is the number that appears in Table C2 in the first row for each program. Successive rows in Table C2 remove unaffected transactions, and the second column of the table describes the reason for the exclusion. The last row for each program reports the number of affected transactions.

a. Reserve Price Optimization

145. Mr. Andrien asserts that the alleged deception regarding RPO led to an increase in the

[307] My exclusion of transactions that could not have been impacted by the alleged deception should not be interpreted as a finding that the remaining transactions were impacted.

[308] [redacted]

[309] [redacted]

[310] See also Table C2 in Appendix C.

average clearing price in AdX auctions.[311] In doing so, Mr. Andrien relies on Professor Weinberg, who asserts that "if the advertiser were aware of RPO, they would have shaded their bid from the beginning."[312] Shading (i.e., lowering) bids could result in lower AdX clearing prices. Professor Weinberg also speculates that "if Google is good at optimizing reserves via RPO, a publisher may wish to lower the reserve it sets on AdX in order to give AdX greater flexibility in optimizing its reserve, which would lead to greater revenues for both AdX and the publisher."[313]

146. However, even if one takes the plaintiffs' theory at face value, Mr. Andrien should have accounted for the fact that RPO did not apply to Google Ads.[314] Because Google Ads was exempt from RPO, there is no reason to believe—and neither Mr. Andrien nor Professor Weinberg provides any evidence, or even asserts—that advertisers using Google Ads would have bid differently absent the alleged deception. For that reason, there is also no reason to believe that publishers—who during this time could set price floors specific to Google Ads[315]—would have modified price floors for Google Ads if RPO had been disclosed.

147. As a result, I exclude from the number of transactions potentially affected by the alleged deception about RPO (i) all AdX transactions for which a Google Ads bid set the clearing price (regardless of whether Google Ads or another bidder won); and (ii) all AdX transactions that Google Ads won and where a price floor set the clearing price.[316] These

[311] Andrien Report at ¶ 35 ("Google also impacted advertiser behavior through its second-price auction representation and concealment of RPO. Namely, I understand that Google's representation that it was running a second-price auction encouraged advertisers to bid their true value for impressions, which over time caused later AdX reserve prices to increase, which, in turn, led to a payoff loss for advertisers by decreasing win rates and increasing the average clearing price in later AdX auctions.").

[312] Weinberg Report at ¶ 285.

[313] Weinberg Report at ¶ 279.

[314] See GOOG-DOJ-13212948 at -948 (naming "GDN" the "prime example" of a buyer exempted from RPO); GOOG-DOJ-13199603 at -603 ("We are exempting bidders (adx 'buyer networks') who submit a second bid to the AdX auction from [RPO] which will effectively make all of GDN demand exempt from [RPO]."). See also Declaration of [redacted], May 2, 2024, GOOG-AT-MDL-C-000017971 ("May 2, 2024 [redacted] Declaration") at ¶ 6 ("RPO did not apply to buyers that submitted two bids into the second-price AdX auction.").

[315] GOOG-AT-MDL-000875073 at -083, showing that under "AdX Open Auction Pricing Rule", publishers could set "per-buyer floor."

[316] I estimate the number of such transactions based on a Google document reporting the percentage of revenue and queries won by either Google Ads or AdX Buyers (i.e., DV360 and Authorized Buyers), by determinant of the clearing price: GDN (Google Ads), "Other AdX Buyers", or floor prices. See Email from [redacted] (Google),

exclusions reduce the number of transactions in which the outcome *could have* been affected by the alleged deception about RPO from [redacted] to [redacted], which is a reduction of [redacted] percent relative to the count after correcting Mr. Andrien's other errors.[317] Overall, the full set of corrections cumulatively reduces Mr. Andrien's count of transactions potentially impacted by the alleged RPO deception from [redacted] to [redacted], a reduction of more than [redacted] percent.[318]

b. DRS v1

148. As with RPO, Mr. Andrien relies on Professor Weinberg in asserting that auction outcomes would have been different but for the alleged deception regarding DRS v1.[319] In particular, Professor Weinberg asserts that advertisers would have shaded their bids had Google revealed DRS v1.[320]

149. Again, however, even if one were to take this assertion at face value, one needs to account for the fact that DRS v1 did not apply to Google Ads.[321] Because Google Ads was exempt from DRS v1, there is no reason to expect—and neither Mr. Andrien nor Professor

"Re: Second pricing mechanism," December 16, 2013, GOOG-DOJ-15719056 at -056. First, the document reports that, post Bernanke implementation (which is the relevant period for an analysis related to RPO), when Google Ads won, [redacted] If alternative documents providing the information I use in my calculations become available, I plan to update my calculations accordingly.

317 [redacted]

318 [redacted]

319 Andrien Report at ¶ 41.

320 Weinberg Report at ¶ 228 ("By not revealing DRSv1 to the advertisers, Google made material gains. This is because if advertisers were to shade their bids, which is the natural bidding behavior in a non-truthful auction like DRSv1, this would lead to less revenue for both AdX and publishers. However, advertisers likely did not shade their bids, since Google never publicly revealed DRSv1.").

321 See GOOG-DOJ-15068390 at -391 ("This launch applies to AdX buyers (incl. DBM) on AdX sellers: [] AdWords (GDN): N[o]").

Weinberg provides evidence, or even asserts—that advertisers using Google Ads would have shaded their bids absent the alleged deception. Similarly, because Google Ads advertisers would not have changed their bidding strategies, there is no reason to believe publishers would have modified price floors for Google Ads bidders if DRS v1 had been disclosed.

150. As a result, I exclude from the number of transactions potentially affected by the alleged deception about DRS v1 (i) all AdX transactions where a Google Ads bid set the clearing price (regardless of whether Google Ads or another bidder won); and (ii) all transactions that Google Ads won where a price floor set the clearing price.[322] These exclusions reduce the number of potentially affected transactions from [redacted] to [redacted], which is a reduction of [redacted] percent relative to the count after correcting Mr. Andrien's other errors.[323] Overall, the full set of corrections reduces the number of transactions potentially impacted by the alleged deception about DRS v1 from the [redacted] estimated by Mr. Andrien to [redacted], which is a cumulative reduction of more than [redacted] percent.[324]

c. DRS v2

151. As explained in Section IV.E(c), Google disclosed DRS v2 before it was launched, so no transactions could have been impacted by any alleged deception related to DRS v2.[325]

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[322] As discussed above in connection with RPO, I estimate the number of such transactions based on a Google document reporting the percentage of revenue and queries won by either Google Ads or AdX Buyers (i.e., DV360 and Authorized Buyers), by determinant of the clearing price: GDN (Google Ads), "Other AdX Buyers", or floor prices. See Email from [redacted] (Google), "Re: Second pricing mechanism," December 16, 2013, GOOG-DOJ-15719056 at -056.

[323] [redacted]

[324] [redacted]

[325] See "2016 releases archive: DoubleClick for Publishers and Ad Exchange Seller," *Google Ad Manager Help*, June 13, 2016, available at https://support.google.com/admanager/answer/7421657?sjid=10086602547051235141-NA#zippy=%2Cjune-change-history-update-safeframe-for-creative-types-deal-check-bid-filter-apply-per-query-revenue-share-optimization (last accessed July 25, 2024) (under the Q2 2016 Ad Exchange release stating "New Ad Exchange control for applying per-query revenue share optimization"); GOOG-AT-MDL-C-000015769. See also Weinberg Report at ¶¶ 197 and 131(c) (explaining that "Google announced DRSv2 when it was launched," but arguing that "if the concept of debt was not clearly disclosed, the general description of DRS as per-query revenue share optimization is insufficient for advertisers to draw conclusions at the level I have drawn in my report."); Andrien Report at ¶ 39 ("Google announced DRSv2 (under a different name) when it was launched and allowed publishers to opt out of the program (if a publisher opted out, DRSv1 was turned off as well), but advertisers and ad buying tools could not.").

This is shown in Table C1 in Appendix C, which reports that the proper count of transactions associated with the alleged deception about DRS v2 is zero.

152. Table C4 in Appendix C reflects the alternative assumption that transactions potentially could have been affected if they occurred between the months when DRS v2 launched (December 2016) and when it ended (July 2018).[326] This period encompasses all transactions that occurred while DRS v2 was in effect and thus reflects the most conservative approach to estimating the period during which transactions potentially were affected by DRS v2.[327] In this analysis, I further assume that the DRS v2 was not disclosed until the complaint was largely unsealed in October 2021[328] (which results in no plaintiff State's statute of limitations barring recovery for the alleged deception about DRS v2).

153. Under these alternative assumptions, I assess how many transactions could have been impacted by the alleged deception about DRS v2, according to plaintiffs' theory. Mr. Andrien relies on Professor Weinberg to explain how the nondisclosure of DRS v2 could impact advertisers.[329] Professor Weinberg asserts that, if DRS v2 were fully disclosed, no advertisers would have placed any bids into the so-called "dynamic region" (i.e., the region where DRS v2 lowered AdX's revenue share).[330] Professor Weinberg's theory indicates that the *only* transactions that could have been affected by the alleged deception regarding DRS v2 are those where the winning bidder either submitted a bid in the

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[326] See Andrien Report, Exhibit 5 (indicating that DRS v2 started on 12/1/2016 and ended on 7/17/2018 and explaining that when "[the beginning of the penalty period] is after the first day of the month, violation count starts on the first day of the following month; if [the end of the penalty period] is after the first day of the month, violation count ends on the last day of the previous month"); see also Defendant Google LLC's First Amended Responses and Objections to Plaintiffs' Third Set of Interrogatories, Responses to Interrogatory No. 6 at 12 ("Dynamic Revenue Share launched on or about August 20, 2015. DRS v. 2 subsequently launched on or about December 1, 2016. tDRS subsequently launched on or about July 17, 2018.").

[327] For example, this analysis accounts for Professor Weinberg's suggestion that Google's disclosure of DRS v2 was not sufficiently detailed. See Weinberg Report at ¶ 231(c) ("If the concept of debt was not clearly disclosed, the general description of DRS as per-query revenue share optimization is insufficient for advertisers to draw conclusions at the level I have drawn in my report…In order for advertisers to have sufficient information regarding DRSv2 in order to avoid paying more than their value for an impression, Google would have needed to disclose a somewhat precise description of the debt concept. I do not know whether Google indeed made such a disclosure, nor how it was made, but in my opinion such information is vital to advertisers, even if they were already aware in a general sense that DRSv2 optimizes revenue shares on a per-query basis.").

[328] Second Amended Complaint ¶ 150, *In re Google Digital Advertising Litig.*, No. 1:21-md-03010-PKC (S.D.N.Y. Oct. 22, 2021), ECF No. 152.

[329] Andrien Report at ¶ 42.

[330] Weinberg Report at ¶ 226.

"dynamic region" (where DRS v2 would lower AdX's revenue share) or the AdX revenue share was increased so that AdX could recoup the lower revenue share on other transactions.

154. Because DRS v2 did not apply to Google Ads and DV360,[331] only the roughly [redacted] percent of transactions that were won by Authorized Buyers could have been impacted by the alleged deception related to DRS v2.[332]

155. To identify the fraction of Open Auction transactions won by Authorized Buyers who bid in the dynamic region, I rely on a Google document reporting that [redacted].[333] In addition, I assume that AdX increased the revenue share on a similar percentage of transactions to maintain its 20 percent average revenue share. [redacted]

156. Table C4 shows that, under the alternative assumption that the penalties period for DRS v2 runs from December 2016 to July 2018, removing unaffected transactions would reduce the count of transactions potentially impacted by the alleged deception from [redacted] to [redacted], a reduction of [redacted] percent.[334]

d. Project Bernanke

157. Mr. Andrien asserts that publishers likely would have changed their reserve prices, and that advertisers would have shaded their bids, if they had known about Bernanke.[335]

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331 Google Ads was excluded from DRS v1 and v2, and starting in November 2016, DV360 was also excluded. See Email from [redacted] (Google), "Fwd: [Monetization-pm] [drx-pm] LAUNCHED! AdX Dynamic Revenue Share (DRS)," September 11, 2015, GOOG-DOJ-15068390 at -391 ("This launch applies to AdX buyers (incl. DBM) on AdX sellers" but not for AdWords (GDN) buyers); Email from [redacted] "[Launch 145022] Dynamic Revshare v2 on Ad Exchange for AdX Buyers," March 10, 2016, GOOG-DOJ-14717283 at -283 ("The scope of this launch is limited to AdX buyers."); Email from [redacted] "OVERDUE LAUNCH – Please update: [Launch 169646] Remove DBM from AdX dynamic revshare," November 9, 2016, GOOG-DOJ-14734878 at -878 ("DBM [now DV360] does not plan to participate dynamic revshare v2.").

332 Calculations reported in workpaper "DTPA DRSv2.xlsx".

333 See GOOG-AT-MDL-007375273 at -273 (in which the reference in this document to "RTB buyers" should be interpreted as both Authorized Buyers and DV360).

334 [redacted]

335 Andrien Report at ¶ 46.

However, Bernanke applied only to Google Ads.[336] As a result, had Bernanke been disclosed, non-Google Ads bidders (i.e., DV360 and Authorized Buyers) would not have had an incentive to shade their bids. There is, therefore, no reason to believe that transactions where the AdX clearing price was set by non-Google Ads bidders would have been impacted by the alleged deception related to Bernanke. Similarly, because non-Google Ads bidders would not have changed their bidding strategies, there is no reason to believe publishers would have set different floors for those bidders if Bernanke had been disclosed.

158. Accounting for these facts, I reduce Mr. Andrien's count of transactions associated with the alleged Bernanke-related deception by excluding: (i) transactions won by Google Ads where non-Google Ads bidders set the clearing price; and (ii) transactions won by non-Google Ads bidders where the clearing price was set by a non-Google Ads bidder or the price floor.[337]

159. In addition, I note that, between May 2016 and September 2019, a "truthful" version of Bernanke applied to Google Ads advertisers who were using autobidding.[338] Because this second version of Bernanke was "truthful," advertisers using autobidding would have had no incentive to modify their bids if Bernanke had been disclosed. As a result, in addition to the exclusions described above, I also exclude transactions occurring between May

[336] Bernanke was a Google Ads program. See GOOG-DOJ-13469175 ("Project Bernanke involves reducing the second price and increasing the first price of the two bids submitted by GDN to the AdX auction.").

[337] As in the case of RPO and DRS v1, I estimate the number of such transactions based on a Google document reporting the percentage of revenue and queries won by either Google Ads or AdX Buyers (i.e., DV360 and Authorized Buyers), by determinant of the clearing price: GDN (i.e., Google Ads), "Other AdX Buyers", or floor prices. See Email from [redacted] (Google), "Re: Second pricing mechanism," December 16, 2013, GOOG-DOJ-15719056 at -056. [redacted]

[338] GOOG-DOJ-AT-02467209 at -209 (indicating that the "truthful" version of Bernanke would "charge the minimum price needed to win the query. No change for non-CO ads.…We propose that for CO [Conversion Optimizer] advertisers (tCPA, fixed CPA, ROAS) gTrade should charge the minimum price to win the query, which makes the traffic look like regular second price auction").

2016 and September 2019 that were won by Google Ads, DV360, or Authorized Buyers and where the clearing price was set by a Google Ads advertiser using autobidding.[339]

160. The net result of these exclusions is to reduce the number of transactions potentially affected by the alleged deception about Bernanke to [redacted]. This represents a [redacted] percent reduction from the [redacted] remaining after accounting for the Bernanke-related errors previously described,[340] and a [redacted] percent cumulative reduction from the [redacted] transactions counted by Mr. Andrien.[341]

e. Alchemist

161. When Google transitioned to a unified first price auction in September 2019, Bernanke was updated and renamed "Alchemist."[342] Mr. Andrien counts all transactions from October 2019 to May 2024 as impacted by alleged deception concerning Alchemist.[343]

162. However, neither Mr. Andrien nor Professor Weinberg has articulated a theory for how the alleged *deception* regarding Alchemist impacts auction participants. Similarly, neither Mr. Andrien nor Professor Weinberg has articulated a theory for how Alchemist was inconsistent with Google's so-called "equal footing" representations. In particular, neither Mr. Andrien nor Professor Weinberg has asserted or provided evidence that AdX treats

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339 The percentage of Google Ads revenue where the advertiser used autobidding is estimated using data produced by Google. See GOOG-AT-DOJ-DATA-000011657 to GOOG-AT-DOJ-DATA-000012656; see also May 3, 2024 Letter from D. Pearl to W. Noss and Z. DeRose Calculations reported in code "Incremental_Revenue_Bernanke.do." [redacted]

340 [redacted]

341 [redacted]

342 See Declaration of [redacted], August 5, 2023, GOOG-AT-MDL-008842383 ("August 5, 2023 [redacted] Declaration") at ¶ 22 ("Google updated the Bernanke algorithms in 2019 to be compatible with the Unified First Price Auction. The updated version of Bernanke was sometimes referred to within Google as 'Alchemist.' The update was designed to maintain incentives for Google Ads advertisers to bid their true values even after Google transitioned to the Unified First Price Auction, while continuing to target a similar aggregate take rate for Google Ads as before the transition to the Unified First Price Auction."); see also GOOG-DOJ-14550102 at -102-104 ("Alchemist is a mechanism that: … Submits first price bids to publishers (while being truthful from buyer's perspective) … Satisfies margin constraint … Maximizes welfare for its spending … Alchemist Online satisfies both of the necessary and sufficient conditions of the Myerson's [sic] theorem and is truthful.").

343 See Andrien Report Exhibit 5 (indicating that "First-Price Bernanke" started on 10/25/2019 and continued to the "present").

bids coming into its auctions differently because of Alchemist. Instead, Alchemist is an optimization feature that Google Ads implements using only its own data (i.e., it did not rely on AdX data) before it submits a bid into the AdX auction.[344]

163. Moreover, Professor Weinberg recognizes that Alchemist is "truthful," which means that bidders maximize their surplus by submitting bids equal to their own values.[345] As a result, there is no reason to believe Google Ads advertisers would have bid any differently if Alchemist had been publicly disclosed. Nor is there any reason to believe that publishers would set different floors if Alchemist had been disclosed. Because neither Mr. Andrien nor Professor Weinberg has provided any economic theory or empirical evidence to suggest that advertisers or publishers would have behaved differently had Alchemist been disclosed, they have provided no basis for assessing the number of transactions, if any, that could have been affected by the alleged deception regarding Alchemist. Similarly, because neither Mr. Andrien nor Professor Weinberg has provided any economic theory or empirical evidence to suggest that AdX treated incoming bids differently because of Alchemist, they have provided no basis for assessing the number of transactions, if any, that could have been affected by the alleged "equal footing" deception about Alchemist. As a result, in both cases, I conclude that the alleged deception regarding Alchemist impacted zero transactions, rather than the [redacted] remaining after the other corrections described above, or the [redacted] counted by Mr. Andrien."[346]

[344] See GOOG-DOJ-06842351 at -359 ("We respect GDN-AdX firewall: we only utilize GDN data to optimize bidding strategy. Any AdX buyer can do this."). [redacted]

[345] Weinberg Report at ¶ 266 ("First-Price Project Bernanke has three components: (a) a bid optimizer for GDN users that makes their participation in AdX's first-price auction truthful, (b) collusion among GDN bidders, which increases GDN's payoff at the expense of publishers' revenue, (c) overbidding, which lowers GDN's and increases publishers' revenue."); *id.* at ¶ 47 ("A sealed bid single-item auction is truthful if each bidder receives the best possible outcome (given the other bidders' bids) by submitting a bid equal to their own value.").

[346] [redacted]

f. Facebook Network Bidding Agreement

164. In discussing Google's Network Bidding Agreement (NBA) with Facebook, Mr. Andrien asserts that "Google provided Facebook with advantages that were not available to other auction participants, and because of the confidentiality of the NBA, such advantages were not disclosed to other participants."[347] However, Mr. Andrien does not examine the extent to which these alleged advantages actually impacted transactions.

165. The Open Auction transaction data on which both Mr. Andrien and I rely show that, since November 2019 (the date when Google allegedly stated that all bidders would be on an "equal footing"),[348] [redacted][351]

H. Mr. Andrien Vastly Overstates the Number of Affected Transactions

166. In my foregoing analysis, I have provided a number of reasons why Mr. Andrien's count of [redacted] greatly exaggerates the number of transactions that could have been affected by the alleged deception. After making all of the corrections described above, the de-duplicated number of transactions that potentially could have been affected by the alleged deception falls to [redacted], a 98 percent reduction,[352] as shown in Figure 1 below.

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[347]Andrien Report at ¶ 53. The NBA is the "Network Bidding Agreement" between Facebook and Google. See GOOG-TEX-00144513. Jedi Blue is Google's internal name for the NBA. FAC at ¶ 425.

[348] See Andrien Report at ¶ 99 and footnote 274.

[349] Calculation based on the AdX data that Andrien uses in his analysis, limited to Open Auction transactions and excluding app transactions (identified based on the "user device" field).

[350] Moreover, in Section VII, I discuss additional reasons why one would expect the impact of the Facebook NBA agreement to be zero.

[351] See Table C1 in Appendix C.

[352] [redacted] Table C1 in Appendix C demonstrates that Mr. Andrien's flawed approach also significantly exaggerates the number of affected transactions if Google is found liable on only a subset of the alleged DTPA claims. See workpaper "Deduplicated Counts all Combinations.xlsx" for more details.

[redacted]

V. Mr. Andrien Has No Basis for His Inflated Per-Violation DTPA Civil Penalties

167. Mr. Andrien asserts that "reasonable and appropriate" per-violation penalties should range from [redacted] There is no economic basis for Mr. Andrien's proposed penalties, which are unrelated to his penalties framework and vastly exceed Google's profit per transaction.

A. Mr. Andrien Has No Basis for His Proposed Per-Violation Penalties

168. Mr. Andrien does not explain or offer any methodology regarding how he arrived at the per-violation penalty amounts that he proposes. Instead, he simply states that he bases his per-violation penalties on "the information available to me as of today, the analysis

[353] Andrien Report at ¶ 128 [redacted]

presented in this report, as well as my education, training and experience."[354] While Mr. Andrien does discuss Google's overall gross revenue and profit, he does not draw any connection between those aggregate amounts and his entirely *ad hoc* per-violation penalties.

169. As discussed in Section III, Mr. Andrien's framework indicates that penalties should be calculated to deprive Google of the incremental benefits from the alleged deception. To implement that framework in an economically appropriate way, Mr. Andrien should have linked his per-violation penalties to the average incremental benefit Google received per affected transaction, but he makes no effort to forge that connection.

B. Mr. Andrien's Per-Violation Penalties are Inflated Relative to His Framework

170. My own economic analysis indicates that Mr. Andrien's proposed per-violation penalty range appears to [redacted]

171. As discussed in Section III.D., as matter of economics, profits, not net revenues, are the correct metric of Google's gains.[356] [redacted]

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[354] Andrien Report at ¶ 128 ("Based upon the information available to me as of today, the analysis presented in this report, as well as my education, training and experience, I conclude that it would be reasonable and appropriate for the trier of fact to assess a penalty in the range of [redacted] for each violation.").

[355] The calculations in the text do not purport to represent any analysis carried out by Mr. Andrien. Rather, these calculations simply document that regardless of how Mr. Andrien arrived at his per-violation penalty amounts, they are in fact roughly similar to [redacted].

[356] As noted above, profits rather than revenues are the appropriate measure of benefits to a firm. A firm can only receive revenues by expending costs, and the benefit that a firm receives from a transaction must be measured by netting out the costs incurred to generate that revenue. Such netting yields profit, which is the correct measure of the benefit derived by the firm.

[redacted]

172. Using a per-violation penalty amount equal to Google's profit per transaction would implement Mr. Andrien's framework by depriving Google of the full benefit that it received from an incremental transaction generated by the alleged deception.[357] For such incremental transactions, Mr. Andrien's framework would imply that the appropriate overall penalty could be determined by multiplying the number of such incremental transactions by [redacted]

[357] These are the transactions that I categorized earlier as exhibiting a "quantity effect."

173. As noted above, however, Mr. Andrien recognizes that not all transactions affected by the alleged deception are incremental. In addition to that "quantity effect," Mr. Andrien also describes a price effect related to transactions that would have occurred on AdX even without the alleged deception, but where the clearing price "was higher than it would have been absent the misconduct."[358] For those transactions, Google's gain is less than all of the profit from the transaction. Instead, Google's gain is only the increase in profit created by the *price increase attributable to the alleged deception*. Determination of Google's alleged benefits for these transactions requires estimation of such price increases and the associated rise in Google's profits.

174. I estimate such benefits to Google in Section VII. For now, I simply note that the gains to Google from such transactions are, on a per-transaction basis, significantly smaller than [redacted] profit that Google earned from each incremental transaction. Accordingly, if one were to average the benefits to Google from the "quantity effect" and the benefits to Google from the "price effect," one would arrive at an average per-violation penalty of [redacted].

175. Further, as I discuss above, Mr. Andrien's calculations of Google's display advertising operating profits are substantially overstated.[359] As such, the operating profit margin I use in my calculation above (row 6 of Table 2), [redacted], are similarly overstated.

176. These results show that Mr. Andrien's per-violation penalties are greatly inflated. The lower end of his penalty range is [redacted] The upper end of Mr. Andrien's range is [redacted] These per-violation penalties are illustrated in Figure 2.

[358] See Andrien Report at ¶ 110.

[359] See Section III.D.

[redacted]

VI. The Cumulative Effect of Mr. Andrien's Errors Is That His Estimated DTPA Civil Penalties Are Grossly Overstated

177. This section demonstrates the combined impact of Mr. Andrien's many errors on his proposed DTPA civil penalties. These errors include a greatly inflated count of transactions and considerably inflated per-violation penalties. Mr. Andrien's total penalties are enormously inflated as a result.

178. Based on Mr. Andrien's de-duplicated transaction counts and his range of per-violation penalties, Figure 3 below shows that Mr. Andrien's flawed approach results in total DTPA

civil penalties ranging from $7.27 billion to $21.81 billion.[360] [redacted]

179. As discussed in Section V, a more appropriate—but still inflated—per-violation penalty amount is [redacted]. My partial correction of Mr. Andrien's errors in counting transactions (based on rows 1 to 6 of Table 1) reduces his count of [redacted] transactions [redacted]. As shown in Section IV.G, further limiting the count to transactions where the alleged deception could have influenced the outcome of an auction reduces Mr. Andrien's count of transactions by 98 percent, [redacted].[363]

180. As Figure 3 shows, using my partially corrected per-transaction penalty [redacted], along with my partial correction of Mr. Andrien's errors in counting transactions, reduces the penalty estimate to $141.3 million, which is 98 percent below the low end of Mr. Andrien's minimum estimate of $7.269 billion.[364] Further, correcting his transaction count

[360] Andrien Report at Table 4 and ¶ 130 ("Assessing this level of penalty per violation would result in a maximum of $21.81 billion in total penalties. The maximum represents total penalties if the trier of fact determined that penalties should only be assessed on the Bernanke claim covering the period November 2013 to present. The maximum also represents the cap on penalties if the trier of fact determines that penalties should be assessed to cover all claims as this figure is based on the total Open Auctions during this period and each auction should only be counted once as a violation.").

[361] Andrien Report at ¶¶ 95, Table 1, and 119. And even this number includes profit from activities that are unrelated to the challenged conduct in this case. For example, Mr. Andrien's [redacted] profit includes profits from AdMob, AdSense for Content, and Campaign Manager, as well as profit made by DV360 and Google Ads when they bid into non-Google exchanges. See *id.* at ¶ 92 ("In order to isolate the revenue and profit associated with the display advertising products at issue in this matter, I only include revenue and profits from the P&Ls related to AdSense for Content, AdX, Doubleclick Bid Manager, AdMob, Doubleclick for Publishers, AdServing, Ad Manager, AwBid, Display & Video 360, Campaign Manager, and Google Ads, which I understand are the products at issue in this matter."). Professor Skinner explains, however, that "Mr. Andrien's estimates of booked revenue and operating profit for 2020–2022 . . . would change if I limit his analyses to the at-issue DVAA products, i.e., to Google Ad Manager, Google Ads, and DV360." Skinner Report at ¶ 50.

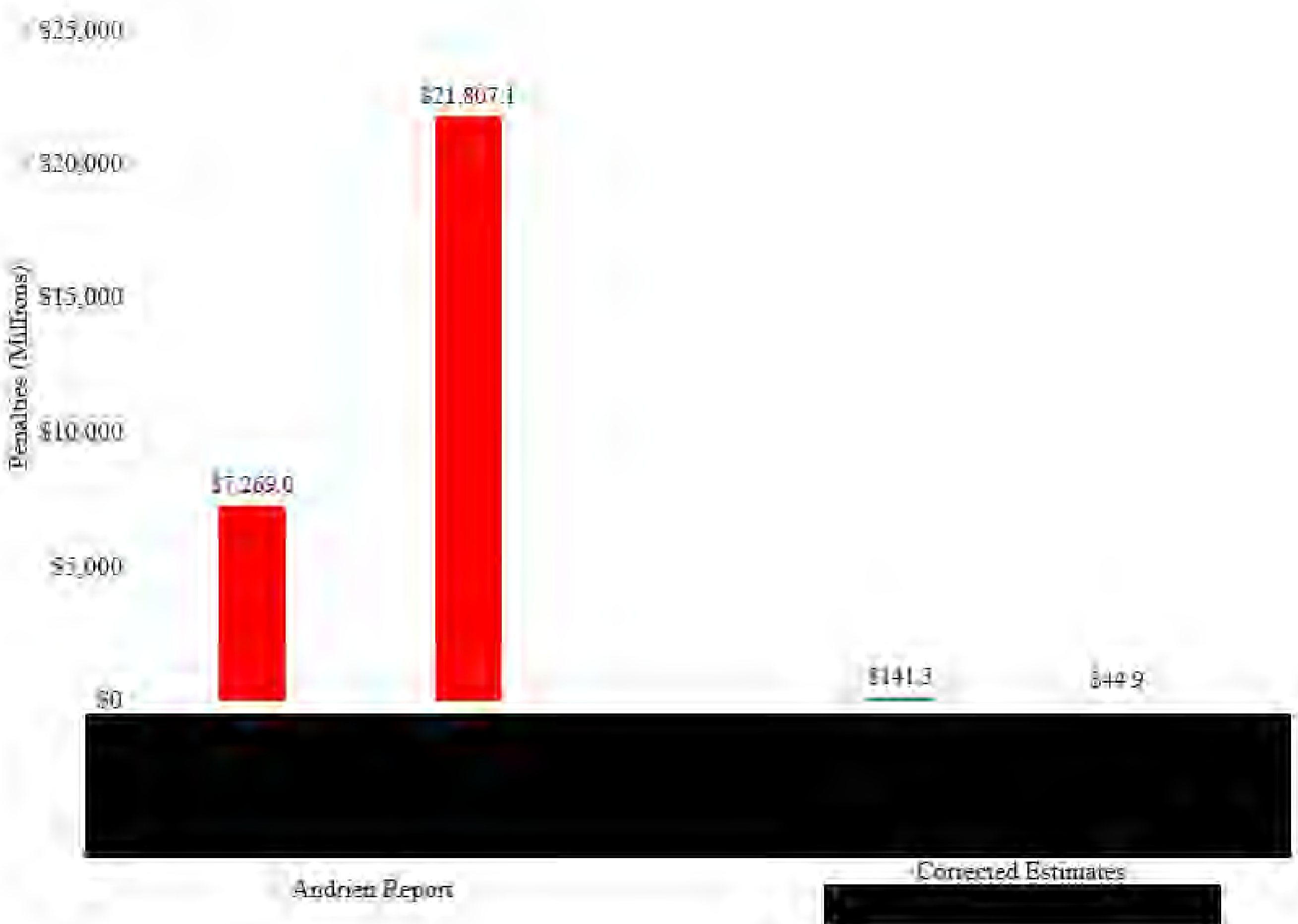
[362] [redacted]

[363] Calculations based on workpaper "DTPA Transaction Count Tables.xlsx."

[364] Note that the above corrections continue to assume *arguendo* based on Mr. Andrien's assumption, that all Open

by including only those transactions that were affected by the alleged deception (as described in Section IV.G) reduces Mr. Andrien's penalty estimate to $44.9 million, which is 99.4 percent below the low end of his penalty range. These reductions are even greater if one compares them to the upper end of his penalty range ($21.81 billion), which is three times larger than the low end of his penalty range ($7.269 billion).

Figure 3
Mr. Andrien's and Partially Corrected Penalty Estimates, Based on De-Duplicated Counts



Notes & Sources: [1] See Tables 1, C.1, and C3. [2] "Partially Corrected Counts" implements corrections 1-6 in Table C1.

181. I emphasize that, while these estimates correct some of the serious errors in Mr. Andrien's analysis, they share a key deficiency with Mr. Andrien's approach to penalties measurement: they do not represent Google's *incremental* benefits from the alleged

Auction transactions were affected, and the corrections above just focus on other errors in his transaction counts. See Andrien Report at ¶ 98.

deception, which are the touchstone of Mr. Andrien's framework.

182. When estimating the incremental benefits to Google from the alleged deception, it is only correct to use a per-violation penalty of [redacted] if one assumes that *all* of the profit associated from each affected transaction was generated by the alleged deception. The *incremental* effect of the alleged deception on Google's profits may be much smaller, resulting in much smaller per-violation penalties.

183. In other words, the analysis in Section IV identifies transactions where the auction outcome *might* have been different as a result of the alleged deception. Estimating the benefits to Google of the alleged deception, however, requires identifying transactions where the clearing price not only *could* have been different absent the alleged deception, but actually *would* have been different *in a way that benefitted Google*.

VII. A Direct Assessment of Google's Benefits from the Alleged Deception Demonstrates that Mr. Andrien Proposes Wildly Disproportionate DTPA Civil Penalties

184. Mr. Andrien contends that the appropriate penalty "must eliminate Google's financial incentive to engage in the alleged misconduct."[365] However, he ignores the obvious way to apply that framework: by directly assessing and estimating the incremental benefits to Google from the alleged deception about each program. While Mr. Andrien asserts that the evidence and data in this case are insufficient to reliably estimate these gains,[366] I do exactly that in this Section. In doing so, I emphasize that benefits from the alleged *deception* are conceptually different from benefits from the *programs* in question.

185. I assess whether, and how much, Google's profits increased as a result of the alleged deception about Reserve Price Optimization, Dynamic Revenue Sharing versions 1 and 2, Project Bernanke, Alchemist, and the alleged "equal footing" deception associated with Alchemist and the Facebook NBA. I do so in two ways. First, I conceptually address the extent to which Google profited from the alleged deception about each program based on the evidence discussed in Section II concerning how advertisers and publishers make

[365] Andrien Report at ¶ 106.

[366] Andrien Report at ¶ 11(f)(ii) ("I am unable to determine Google's total incremental benefits from the misconduct because Google has not produced information sufficient to determine even the direct benefits from the alleged misconduct, much less the indirect benefits from the alleged misconduct.").

decisions in the real world. Second, consistent with Mr. Andrien's approach[367] but contrary to the evidence discussed in Section II, I perform an empirical analysis that assumes (contrary to the evidence in this case) that advertisers and publishers do not learn and adapt their strategies in response to the feedback they receive in the marketplace.[368] Using that approach, I estimate Google's incremental profit from the alleged deception about RPO, DRS v1, DRS v2, and Bernanke.

A. Reserve Price Optimization

186. Following a period of limited-scale experimentation, Google launched Reserve Price Optimization (RPO) on or about April 2015.[369] The company disclosed RPO in May 2016.[370] RPO was discontinued in September 2019 with the introduction of the Unified First Price Auction (UFPA), and Google publicly announced its reintroduction of a version of RPO designed for first price auctions in June 2022.[371]

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[367] See, e.g., Andrien Report at ¶ 41 ("It is my understanding that Google concealed material information from publishers and advertisers by not disclosing DRSv1, which negatively impacted them and *prevented them from employing optimal strategies*.") (emphasis added); *id*. at ¶ 34 ("[B]y concealing RPO, Google prevented publishers from effectively optimizing revenue.").

[368] The fact that advertisers and publishers make decisions by continually monitoring return metrics and optimizing indicates they would have arrived at the same strategies in the but-for world as they did in the actual world. As discussed in each subsection below, that implies that Google did not benefit from the alleged deception. By assuming that advertisers would behave differently in the but-for world (contrary to the evidence of advertiser and publisher behavior in the real world), the quantitative estimates discussed in the sub-sections below overstate the gains to Google from the alleged deception, and thus are conservative.

[369] See Defendant Google LLC's First Amended Responses and Objections to Plaintiffs' Third Set of Interrogatories, May 24, 2024, at 12 ("Reserve Price Optimization launched on or about March 31, 2015. RPO v.2 subsequently launched on or about October 5, 2015. Prior versions of RPO were disabled along with the Google Ad Manager switch to first-price auctions in September-October 2019. In June 2022, Google launched a version of RPO designed for Ad Manager's first-price auction, known as Optimized Pricing, on select web traffic, and it was extended to all web traffic in January 2023."); see also Email from [redacted] (Google), "Re: [drx-pm] LAUNCHED! Dynamic Pricing ('RPO') for AdX sellers," November 11, 2015, GOOG-DOJ-07235914 at -915 ("Between April and October [2015] we launched and improved new systems to dynamically set auction reserve prices for AdX sellers."); May 2, 2024 [redacted] at ¶ 3 ("In April 2015, Google launched Reserve Price Optimization for general availability (having conducted small scale testing of the feature in 2014).").

[370] See Bellack, Jonathan, "Smarter optimizations to support a healthier programmatic market," *Google Ad Manager Blog*, May 12, 2016, available at https://blog.google/products/admanager/smarter-optimizations-to-suppor/ (last accessed July 26, 2024); GOOG-AT-MDL-C-000015606 at -611-612; see also Email from [redacted] (Google), "[ANNOUNCED] Smarter optimizations for DoubleClick Ad Exchange," May 12, 2016, GOOG-DOJ-04934481 at -481.

[371] See GOOG-DOJ-14030931 at -931 ("[redacted]"); "2022 Google Ad Manager releases archive," *Google Ad Manager Help*, June 6, 2022, available at https://support.google.com/admanager/answer/11586212 (last accessed July 25, 2024) (June 6, 2022 archived release on "Manage inventory" notes that "Optimized pricing increases auction

187. The plaintiffs allege that Google's failure to disclose RPO was deceptive because, while the company represented to advertisers that it ran second-price auctions for display ad impressions, RPO implemented changes that "meant that the auction did not operate as a sealed second price auction."[372] According to their theory, had Google disclosed RPO, advertisers allegedly would have "engaged in alternative bid strategies that did not disclose their true value for each impression."[373] Similarly, Professor Weinberg asserts that "if the advertiser were aware of RPO, they would have shaded their bid from the beginning."[374] Mr. Andrien reiterates this assertion.[375] Thus, the plaintiffs' theory of harm regarding the alleged deception about RPO hinges on the extent to which advertiser bidding behavior in AdX Open Auctions in the actual world was different from their bidding behavior in the but-for world absent the alleged deception.

188. In assessing the extent to which the actual and but-for worlds differ, it is important to consider the economics underlying advertiser behavior. As described in Section II.B., as a general rule, advertisers, advertising agencies, and ad buying tools monitor performance and run experiments to help advertisers optimize their bidding strategies. By contrast, neither Mr. Andrien nor Professor Weinberg have presented evidence that advertisers commonly study announcements regarding optimization features and formulate their strategies based on those announcements. The fact that advertisers continually monitor performance and learn to adopt optimal strategies based on their observations means that they would continue to do so regardless of whether RPO was publicly announced. As a result, outcomes in the actual and but-for worlds would be the same, which indicates that Google did not profit from the alleged deception.

189. Advertisers and their advertising agencies and ad buying tools are particularly likely to test for the presence of dynamic floors like RPO, and to develop optimal responses to

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floor prices to more accurately reflect and protect your inventory's value. Optimized pricing is enabled by default, but can be disabled via your network settings"); see also May 2, 2024 [redacted] at ¶ 7 ("RPO was disabled in 2019 following Google's move to the Unified First-Price Auction. In June 2022, Google launched a version of RPO designed for the first-price auction known as Optimized Pricing on select web traffic, and it was extended to all web traffic in January 2023. Publishers may opt out of Optimized Pricing.").

[372] FAC ¶ 532.

[373] FAC ¶ 533.

[374] Weinberg Report at ¶ 285.

[375] See Andrien Report at ¶ 35, footnote 94 ("As Dr. Weinberg opines, if advertisers had been aware of RPO, they could have improved their gains over time by shading their bids from the beginning.").

them.[376] In fact, dynamic floor optimization on AdX existed even before RPO, which means that advertisers should have already been attuned to them and been prepared to adjust their strategies to account for dynamic floors.[377] Similarly, dynamic price floors were common in the industry, which means that advertisers, their ad buying tools, and their advertising agencies had to develop strategies to optimally respond to them.[378] Hence

[376] Email from [redacted] (Google), "Re: [drx-pm] Op-ed that RIB should move to first price auction -- what do you think?," August 15, 2015, GOOG-DOJ-13350192 at -198 ("[S]mart buyers [redacted] use a portion of budget for price discovery and probing of auction dynamics to find how to bid the lowest and not be the ones stuck paying the highest bid premium in a pseudo 1st price auction…. At the end of the day pubs care about yield, they don't care the slightest about auction dynamics.").

[377] Starting in 2011 (i.e., well before the launch of RPO), Google offered publishers a Minimum CPM Recommendation feature, internally called AdX Seller Reserve Price Optimization. See GOOG-DOJ-12439154 at -154 (AdX Seller Reserve Price Optimization "Status: launched on Q2 2011"); see also Semret, Nemo, "Introducing Minimum CPM Recommendations on DoubleClick Ad Exchange," *DoubleClick Publisher Blog*, November 1, 2011, available at https://doubleclick-publishers.googleblog.com/2011/11/introducing-minimum-cpm-recommendations.html (last accessed July 25, 2024) ("[W]e've heard from our publisher partners that they would like to better manage their minimum CPM, sometimes called the reserve or floor price, which dictates the minimum price at which buyers can purchase their inventory. But setting the best minimum price can be tricky. Setting it too high can price publishers out of transactions, while setting it too low can sometimes leave money on the table. Many publishers optimize their minimum CPM using a trial and error approach, which can be time consuming and potentially costly…. Today, we're happy to announce the launch of Minimum CPM Recommendations for DoubleClick Ad Exchange publishers. This feature automatically recommends an optimal minimum cpm for each eligible ad slot in the Ad Exchange auction. It also automatically generates a graph that provides better visibility into how different floor prices might affect a publisher's bottom line."). The Minimum CPM Recommendation feature used [redacted] bids to determine optimal floor price recommendations, which it provided to publishers along with a graph showing how different floors were expected to affect publisher revenue. See GOOG-DOJ-12439154 at -156 ([redacted]"). The publisher had to set the floor manually. GOOG-AT-MDL-010338120 at -120 ("[T]he min cpm is set by a human entering a number into a text box in the adxseller UI."). Unlike the Minimum CPM Recommendation feature, RPO increased floor prices for publishers automatically.

[378] 30(b)(1) Deposition of [redacted] (Google), November 15, 2023, at 174:15 – 175:5 (explaining that "in any auction marketplace … it is expected that the seller tries to come up with smart way to come up with a reserve price to get and claim a bigger share of the profit. … it is always expected that the auctioneer, they try to come up with the reserve prices that maximizes their – basically, their … revenue."); [redacted]

it is not obvious that the implementation of RPO created *further* incentives for advertisers to perform tests and develop optimal responses, such as bid shading, to price floors. Thus, even if RPO had been disclosed, it is unlikely that advertisers would have changed their behavior or strategies from what they were already doing.[379]

190. As a result, there are good economic reasons to believe that a but-for world without the

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[redacted]

Industry press also confirm ad exchanges generally have features like dynamic floor pricing. See Picard, Eric, "Publishers, Don't Settle for Below-Floor Pricing," *AdExchanger*, November 1, 2023, available at https://www.adexchanger.com/the-sell-sider/publishers-dont-settle-for-below-floor-pricing/ (last accessed July 25, 2024) ("Supply-side platforms (SSPs) were born to protect publishers' interests in an automated auction environment. They introduced features like dynamic floor pricing to ensure that demand-side platforms (DSPs) pass on their best bids into the auction."); Bender, Gabe, "Dynamic Price Floors: A Call For Standardization," *AdExchanger*, June 3, 2016, available at https://www.adexchanger.com/the-sell-sider/dynamic-price-floors-call-standardization/ (last accessed July 26, 2024) ("Second-price auctions do, however, perpetuate price inefficiencies by creating large gaps between the buyer's winning bid and the price they actually pay.… Most exchanges have responded with a range of tactics to reduce this inefficiency, claiming to offer sophisticated dynamic price floors. In reality, these platforms resort to soft price floors, phantom bidders, buyer discrimination or some mix of the above, none of which are particularly effective. These opaque solutions end up resembling first-price auctions, jeopardizing the trust of both buyers and sellers. Demand-side platforms (DSPs) then respond by sometimes contractually prohibiting such practices.").

[redacted]

[379] See 30(b)(1) Deposition of [redacted] (Google), November 15, 2023, at 174:15-175:5 (Google buyside engineer explaining that "in any auction marketplace … it is expected that the seller tries to come up with smart way to come up with a reserve price to get and claim a bigger share of the profit. … it is always expected that the auctioneer, they try to come up with the reserve prices that maximizes their – basically, their … revenue."); [redacted]

As discussed in Section II.B, there is also evidence that ad buying tools actively probed general auction dynamics in order to generate the best returns possible for advertisers. See Email from [redacted] (Google), "Re: [drx-pm] Op-ed that RTB should move to first price auction – what do you think?," August 15, 2015, GOOG-DOJ-13350192 at -198 ("[S]mart buyers [redacted] use a portion of budget for price discovery and probing of auction dynamics to find how to bid the lowest and not be the ones stuck paying the highest bid premium in a pseudo 1st price auction.… At the end of the day pubs care about yield, they don't care the slightest about auction dynamics.").

alleged deception about RPO would be the same as, or largely similar to, the actual world. In both worlds—with and without the disclosure of RPO—advertisers would have learned how to shade their bids to arrive at the same optimal bidding strategy. Similarly, to the extent that it was optimal for publishers to change their floors given the operation of RPO,[380] publishers would have done so regardless of whether RPO was disclosed because, in both the actual and but-for worlds, they would monitor returns and perform experiments to arrive at the optimal price floors.[381] Moreover, if some advertisers or publishers were uninterested or unskilled at monitoring returns or optimally adapting, there is no evidence to suggest that such parties would respond with greater interest or skill to disclosures about RPO. As a result, the economics implies that Google was unlikely to benefit from the alleged deception about RPO because the underlying behavior of publishers and advertisers was unlikely to be meaningfully different.

191. This conclusion is supported by both ordinary-course-of-business documents[382] and an empirical analysis of the available data. For that empirical analysis, I use the fact that, on May 12, 2016, Google announced that AdX was using historical data to set price floors, the objective of which was to increase publishers' revenue.[383]

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[380] Mr. Andrien asserts that "by concealing RPO, Google prevented publishers from effectively optimizing revenue." Andrien Report at ¶ 34. In doing so, Mr. Andrien relies on Professor Weinberg, who asserts that "via concealing RPO, Google prevented the publishers from effectively optimizing revenue." Weinberg Report at ¶ 279. However, to my knowledge, none of the plaintiffs' experts have proposed a theory by which publishers would have changed their floors in a way that would have caused an unambiguous reduction in Google's profit. As a result, it is ambiguous whether this behavioral response by publishers implies that the deception increased Google's profit.

[381] As I discussed in Section II.B, publishers' decisions about floor prices are inherently the result of a data driven process where floors are adapted to the bidding behavior of advertisers. For example, Google's RPO feature itself selected publisher-specific revenue maximizing floor prices using *data* on the bids on a publisher's inventory from the previous day. See GOOG-DOJ-13199480 at -483 (RPO used a [redacted] pipeline to compute [a] pricing file based on [redacted] data"). At a high level, RPO "involve[d] 3 simple steps": (i) "Bucket your impressions by features you believe are important to buyers, and record the winning [historical] bids and [historical] transaction prices in each bucket." (ii) "For each bucket, generate a histogram of historical bids and [historical] transaction prices. Use this histogram to model what the [publisher] revenue would be at a range of possible reserve prices." (iii) "Pick a reserve price that maximizes predicted revenue [for the publisher], constrained to limit the fraction of bids it eliminates [by setting the reserve price higher] (to preserve match rate)." GOOG-DOJ-07235914 at -915, 916.

[382] See, e.g., Email from [redacted] (Google), "Re: Observing optimizations (RPO?) in the wild," March 18, 2016, GOOG-TEX-00982249 at -249 ("[redacted] *id*. at -259 ("Another report of 'dynamic floors' being observed."); see GOOG-DOJ-05311280 at -280 [redacted]).

[383] See Bellack, Jonathan, "Smarter optimizations to support a healthier programmatic market," *Google Ad Manager Blog*, May 12, 2016, available at https://blog.google/products/admanager/smarter-optimizations-to-suppor/ (last

192. This disclosure provides the opportunity to test directly how the alleged deception regarding RPO affected the clearing prices (i.e., CPMs) of AdX auctions. A finding that CPMs fell abruptly following this May 2016 disclosure, or in the months after, would indicate that Google earned higher profit as a result of the failure to disclose RPO earlier than it would have absent the alleged deception. Such a pattern would also suggest that bidders' strategies adapted to the public disclosure of information about RPO and thus would be consistent with plaintiffs' view of how advertisers behave.[384] On the other hand, a finding that CPMs did not fall after the disclosure of RPO would be inconsistent with the plaintiffs' theory and indicate that the alleged concealment of RPO did not generate additional profit for Google via higher clearing prices. This result could occur because advertisers' optimal strategy in response to a fully disclosed RPO would have involved little to no bid shading, because advertisers had already learned how to shade their bids and so had already adapted to RPO prior to the public disclosure, or because announcements about optimization features are simply not a primary focus of advertisers in choosing their strategies.

193. I test for an abrupt decline in clearing prices using an econometric methodology known as "regression discontinuity design" which is commonly used in modern economics, and is in part responsible for what Nobel Laureate and MIT Professor of Economics Joshua Angrist has called the "credibility revolution" in empirical economics.[385] The intuition behind the approach is that, so long as other determinants of the outcome vary "smoothly" (i.e., do not change abruptly) across the disclosure "threshold" (i.e., around the date of the disclosure) and are accounted for by properly fitting the underlying trends in the data, then any discontinuity in the outcome that occurs at the time of the announcement is properly

accessed July 26, 2024) ("Optimized pricing in the Open Auction uses historical data to automate the post-auction analysis and updating of floor prices that publishers already do, and takes it a step further."); GOOG-AT-MDL-C-000015606 at -611-612; see also Email from [redacted] (Google), "[ANNOUNCED] Smarter optimizations for DoubleClick Ad Exchange," May 12, 2016, GOOG-DOJ-04934481 at -481.

[384] Note that, under plaintiffs' theory, the disclosure created, at a minimum, a substantial shift in public information in the market which, even if not understood by all, would have led to significant changes in bidding.

[385] See Angrist, Joshua D. and Jörn-Steffen Pischke, "The Credibility Revolution in Empirical Economics: How Better Research Design Is Taking the Con Out of Econometrics," *Journal of Economic Perspectives*, Vol. 24, No. 3, 2010, at 3-30. The increased popularity of this method can be seen in Figure 6.1 of a commonly used graduate-level textbook called *Causal Inference: The Mixtape* by Dr. Scott Cunningham, Yale University Press, 2021, at 241-252, available at https://mixtape.scunning.com/06-regression_discontinuity (last accessed July 25, 2024).

interpreted as the effect of the disclosure.[386] I also test for effects in the months following the announcement.

194. The disclosure of RPO is well-suited for this approach because, to my knowledge, no major optimization features changed in May of 2016 that would cause an abrupt change in auction clearing prices.[387] In addition, the disclosure itself was likely unanticipated, and there was no opportunity for the type of strategic behavior by market participants that would invalidate the approach.[388] One element of this regression discontinuity approach is shown in Figure 4, which graphically presents the impact of the disclosure of RPO on average CPM in AdX. More specifically, I focus on the natural logarithm of CPM, which means that differences from one month to another can be interpreted as percentage changes.[389] Note that, to isolate variation that is potentially due to RPO, I also follow standard practice and adjust the data to remove month-to-month changes attributable to seasonal factors.[390]

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[386] This is referred to as the "continuity assumption" of regression discontinuity design. See Cunningham, Scott, *Causal Inference: The Mixtape*, Yale University Press, 2021, at 252-282, available at https://mixtape.scunning.com/06-regression_discontinuity (last accessed July 25, 2024).

[387] I note that RPO was launched in April 2015, over one year before the announcement. As a result, RPO implementation itself does not affect CPM around the time of the announcement and my analysis can clearly isolate the effect of the alleged deception.

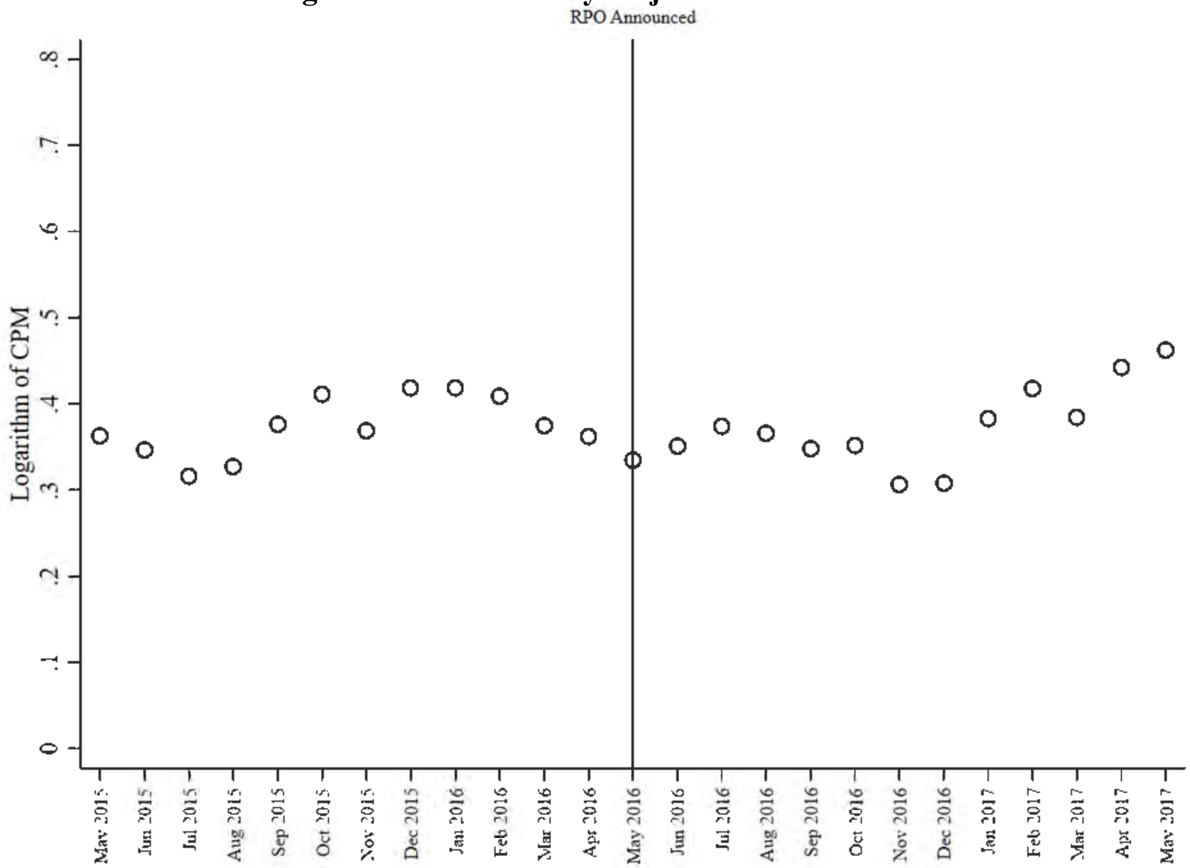
[388] Economists refer to this type of strategic behavior as "manipulation around the threshold." For example, in this setting, one might ask whether some advertisers could have postponed ad spending from the days before the RPO disclosure to the days after the RPO disclosure. The absence of manipulation around the threshold is a technical condition required for the validity of the empirical exercise. See McCrary, Justin, "Manipulation of the running variable in the regression discontinuity design: A density test," *Journal of Econometrics*, Vol. 142, No. 2, 2008, pp. 698-714.

[389] For example, a change of 0.1 is interpreted as a 10 percent increase. See Ford, Clay, "Interpreting Log Transformations in a Linear Model," *University of Virginia Library*, August 17, 2018, available at https://library.virginia.edu/data/articles/interpreting-log-transformations-in-a-linear-model (last accessed July 25, 2024).

[390] Seasonal adjustment is a standard and accepted technique that is applied by econometricians to remedy issues that otherwise would render statistical inference unreliable. For an intuitive, if simplified, explanation of the need for and uses of seasonal adjustment, see, e.g., Maddala, Gangadhar Rao S., *Econometrics*, McGraw-Hill College, 1977 at 338-342. For a more advanced treatment, see, e.g., Greene, William H., *Econometric Analysis*, Prentice Hall, 7th ed. 2012, at 192-194.

I perform seasonal adjustment using the full sample of data from 2014 through 2019. The intuition of this seasonality adjustment is that, if CPMs are 10 percent higher in December across the full sample, I reduce each December CPM accordingly. Formally, I do this by regressing the log CPM on month fixed effects. The residuals from this regression can be interpreted as changes in CPM that are not explained by seasonality. I then compute the seasonally-adjusted CPM for each month in the sample by adding the residuals from that regression to the average outcome over the 21-month period that includes a window around the disclosure in May of 2016. Adding the average CPM is just a normalization that shifts up the monthly residuals by the same amount in each month but has no effect on the

Figure 4
Natural Logarithm of Seasonally-Adjusted CPM in AdX Auctions



Notes: [1] Limited to U.S. users. [2] Excludes app and video transactions. [3] CPM is seasonally adjusted.
Sources: AdX Data (see Appendix H for Bates numbers).

195. Figure 4 shows no evidence of a reduction in average CPM in AdX following the disclosure. Rather, average CPM appears to vary smoothly around the time of the disclosure. This result contrasts directly with the plaintiffs' and their experts' assertions that the alleged deception caused advertisers to pay higher prices than they would have but-for the alleged deception.[391] If the plaintiffs and their experts were correct, then

resulting estimates. Results are robust to using alternative numbers of months before and after disclosure (e.g., 12 or 8), as Figure 4 below illustrates.

[391] See Andrien Report at ¶ 35 ("Namely, I understand that Google's representation that it was running a second-price auction encouraged advertisers to bid their true value for impressions, which over time caused later AdX reserve prices to increase."); Weinberg Report at ¶ 285 ("[I]f the advertiser were aware of RPO, they would have shaded their bid from the beginning."); FAC ¶ 533 ("Google failed to disclose that it would use historical bidding information to artificially drive up the second price, by increasing publisher's preset price floor and replacing it with an artificially

publicly revealing RPO should have led advertisers to reduce their bids, which would in turn reduce CPM. I find no evidence of such reductions.

196. In Table 3, I continue this analysis with regression estimates of the discontinuity at the time of the disclosure.[392] To assess robustness, I present a variety of alternative specifications: (i) I use different numbers of months of data (24 months of data – *i.e.*, 12 months of data both before and after the disclosure – as well as 20, 16, 12, and 8 months); and (ii) I use linear "fits" of the data (which is the assumed "shape" of how CPM changes over time) for all time windows, as well as quadratic fits for the larger data sets where "overfitting" is less of a concern.[393]

Table 3
Estimated Effect of Google's Disclosure of RPO on CPM

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
# of Months Included	24	24	20	20	16	16	12	8
Assumed Functional Form (Quadratic or Linear)	Quad.	Lin.	Quad.	Lin.	Quad.	Lin.	Lin.	Lin.
Estimated effect of disclosure[1]	0.023	-0.087	0.064	-0.069	0.058	-0.020	0.007	0.024
P-value from a two-sided test of statistical significance (t-statistic based)[2]	[0.813]	[0.208]	[0.404]	[0.25]	[0.554]	[0.589]	[0.95]	[0.453]

Notes: [1] Estimates are interpreted as the effect of the May 16, 2016 disclosure of the mechanics underlying RPO, and are derived using the natural logarithm of CPM the dependent variable. [2] The test of statistical significance is the two-sided empirical p-value from a permutation test, which measures the fraction of possible t-statistics that are at least as extreme, in absolute value, as the t-statistic from the estimated effect of the actual May 16, 2016 disclosure. It comes from estimating "effects" of placebo policies using time periods of the same length throughout the full sample. To mirror the non-placebo regressions, the placebo disclosure month is excluded from each regression. [3] CPM is seasonally adjusted using data from 2014 to 2019. [4] Data are limited to US users, Open Auctions, web, and non-video transactions. [5] May 2016 is excluded from the sample, since the mechanics of RPO were publicly disclosed midway through that month.
Sources: AdX Data (see Appendix H for Bates numbers)

197. Results from Table 3 indicate that disclosure of RPO was associated with no meaningful changes in average CPM in AdX. In particular, none of the changes are statistically different from zero. Moreover, the point estimates vary from positive to negative, and this variation in sign confirms a lack of systematic evidence of significant change.

198. More specifically, the estimated changes in CPM range between negative 0.087 log points

inflated floor derived from advertiser's historical bidding information. This resulted in the advertiser paying significantly higher prices than the true second price.").

392 Results from regression discontinuity analysis is included in workpaper "RD Regression Tables.xlsx."

393 See Gelman, Andrew and Guido Imbens, "Why High-Order Polynomials Should Not Be Used in Regression Discontinuity Designs," *Journal of Business & Economic Statistics*, 2018.

(-8.3%) in Column 2, and positive 0.064 log points (6.6%) in Column 3.[394] While some estimates from approaches that use more data and a linear "fit" result in negative estimates (i.e., Columns (2) and (4)), allowing for either a more flexible quadratic fit (such as in Columns (1) and (3)) or using only data that are closer to the date of the announcement results in estimates that are often positive and frequently close to zero. More importantly, the lack of statistical significance of any of these estimated changes means that, under the standards commonly applied by economists, it cannot be established that any of these changes are statistically different from zero. As a result, the appropriate interpretation of the results in Table 3, as well as the underlying data shown in Figure 4, is that there is no evidence that the disclosure of RPO resulted in advertisers on average paying lower CPMs on AdX transactions and, thus, no evidence that the alleged deception about RPO increased Google's net revenue or profits by inflating CPM.

199. In order to assess whether the estimates in Table 3 are statistically different from zero, I employ a method called permutation-based inference, also known as randomization inference, which is commonly used in applied economics.[395] Specifically, for each column in Table 3, I constructed every possible data series of the same length and assumed that a "placebo" (i.e., not occurring in reality) disclosure occurred in the middle of that series. For example, for Column (1): (i) I constructed every possible 25-month sample from January 2014 through December 2019 (i.e., a sample consisting of 12 months before and 12 months after the month of the placebo event, plus the month of the event);[396] (ii) I

[394] In this semilogarithmic regression, the percentage change of the dependent variable is given by 100 × (exp(β) – 1), where β is the estimated coefficient of the discrete variable under consideration. See, e.g., Halvorsen, Robert and Raymond Palmquist, "The Interpretation of Dummy Variables in Semilogarithmic Equations," *American Economic Review*, Vol. 70, 1980, pp. 474-75. Here, the discrete variable at issue takes the value of 1 after the disclosure of RPO and zero otherwise. In column (2) of Table 3, the value of β is -0.087. Hence the percentage change in the natural logarithm of CPM following the RPO disclosure can be calculated using the following equation: 100 × (exp(-0.087) – 1) = -8.3%. The estimated increase in CPM in column (3) is likewise calculated using a similar equation: 100 × (exp(0.064) – 1) = 6.6%.

[395] See, for example, Cunningham, Scott, *Causal Inference: The Mixtape*, Yale University Press, 2021, available at https://mixtape.scunning.com/10-synthetic_control (last accessed July 25, 2024). This approach to measuring statistical significance accounts for the major form of uncertainty in this context, which is what economists call 'design-based uncertainty.'" See Rambachan, Ashesh and Jonathan Roth, "Design-Based Uncertainty for Quasi-Experiments," *Working Paper*, 2020, available at https://scholar.harvard.edu/sites/scholar.harvard.edu/files/jroth/files/DesignBasedQuasiExperiments.pdf (last accessed July 25, 2024).

[396] When using the 72-month data from January 2014 to December 2019, there are 48 (72 – 12 – 12) "placebo" effects using a 12-month bandwidth (i.e., 12 months of data on each side of the "placebo" threshold).

defined a placebo disclosure to occur in the 13th month of that sample, just as it did in the actual sample used in Column (1); and (iii) I estimated the effect of the "placebo" event, along with the corresponding t-statistic.[397] Below each estimate in Table 3, I report the fraction of t-statistics that are of equal or larger absolute magnitude than the *t*-statistic corresponding to the estimate for the actual disclosure.[398] This is what economists and statisticians often refer to as a two-sided empirical p-value.[399] It is the fraction of possible estimates that are at least as extreme as the main estimate of interest. This method of testing for statistical significance avoids false inferences.[400]

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[397] The *t*-statistic is the estimated ratio of the coefficient to the standard error for that coefficient. Economists routinely employ *t*-statistics to test whether the estimated coefficients of regression equations are statistically significant. See, e.g., Verbeek, Marno, *A Guide to Modern Econometrics*, Wiley, 5th ed. 2017, at pp. 20, 23-25.

[398] Research finds that randomization inference performs better in some settings when using *t*-statistics as the test coefficient, rather than coefficients. See MacKinnon, James G. and Matthew D. Webb, "Randomization inference for difference-in-differences with few treated clusters," *Journal of Econometrics*, Vol. 218, 2020, pp. 435-450, at 435 ("We study two randomization inference (RI) procedures. A procedure based on estimated coefficients may be unreliable when clusters are heterogeneous. A procedure based on *t*-statistics typically performs better (although by no means perfectly) under the null, but at the cost of some power loss."); see also Feinstein, Steven and O. Miguel Villanueva, "Securities Litigation Event Studies in the Covid Volatility Regime," *Journal of Forensic Economics*, Vol. 31, No. 1, 2024, at 8-9 ("In this paper, we propose using the empirical distribution of daily stock return *t*-statistics during the Covid period to identify the critical values for the statistical significance test. For any stock during the Covid period, one can precisely find from the empirical distribution the 5% frequency *t*-statistic values and use those values as the critical values to test for return significance. Event returns with *t*-statistics in the top 2.5% or bottom 2.5% of the observed *t*-statistics are sufficiently unusual that one can reasonably deem them to be significant, unlikely to have been merely random fluctuations.… We find that the methodology restores correct test size, i.e., eliminates spurious significance, while preserving substantial test power to identify the significant impact on stock prices of earnings announcements in the Covid period."); Shea, John, "Union Contracts and the Life-Cycle/Permanent-Income Hypothesis," *American Economic Review*, Vol. 85, No. 1, 1995, at 198. Results are similar when using coefficients as the test statistic, rather than *t*-statistics. In particular, the empirical p-values corresponding to estimates in Columns (1) – (8) of Table 3 are 0.729, 0.104, 0.423, 0.132, 0.5, 0.571, 0.95, and 0.625, respectively.

[399] See, e.g., Knijnenburg, Theo A., Lodewyk F.A. Wessels, Marcel J. T. Reinders, and Ilya Shmulevich, "Fewer permutations, more accurate P-value," *Bioinformatics*, Vol. 25, No. 12, 2009, at i161 ("Permutation tests have become a standard tool to assess the statistical significance of an event under investigation. The statistical significance, as expressed in a *P*-value, is calculated as the fraction of permutation values that are at least as extreme as the original statistic, which was derived from non-permuted data."); see also Brantingham, Jeffrey P., George Mohler, and John MacDonald, "Changes in public-police cooperation following the murder of George Floyd," *PNAS Nexus*, Vol. 1, No. 5, 2022, pp. 1-11; Carrell, Scott E., Bruce I. Sacerdote and James E. West, "From Natural Variation to Optimal Policy? The Importance of Endogenous Peer Group Formation," *Econometrica* Vol. 81, No. 3, 2013, pp. 855-882; Bhargava, Saurabh and Ray Fisman, "Contrast Effects in Sequential Decisions: Evidence from Speed Dating," *Review of Economics and Statistics*, Vol. 96, No. 3, 2014, pp. 444-457; Cattaneo, Matias D. and Rocio Titiunik, "Regression Discontinuity Designs," *Annual Review of Economics*, Vol. 14, 2022, at 839.

[400] This fact is demonstrated by examining the frequency with which estimates from the permutations described above are statistically significant when using standard errors from the standard regression. If a method of testing for statistical significance is correct, then approximately 5% of "placebo" estimates should be statistically significant at the 5% level. Instead, I find statistical significance rates are much too high, which indicates that method is incorrect. For example, among estimates from the full set of possible permutations corresponding to the samples and specifications shown in Columns (1) through (8) of Table 3 (i.e., those permutations used in the randomization

200. Economists usually consider p-values in excess of 5% or 10% as evidence that an estimate is not statistically different from zero (i.e., that the estimated effect is not statistically significant). Because none of the empirical p-values in Table 3 are smaller than 5 or even 10 percent—in fact, the smallest empirical p-value is 20.8 percent (in Column (2))—the estimates are not statistically significant.

201. It is important to note that this statistical insignificance is also consistent with the lack of visually compelling discontinuities in Figure 4 at the time of the announcement and provides further evidence that the disclosure of RPO had no measurable impact on average CPMs in AdX. The results indicate that the world without the alleged deception about RPO would have been materially the same as the world with the alleged deception. For that reason, the evidence indicates that the alleged deception regarding RPO did not generate additional net revenue, or profits, for Google.

202. I also performed two other tests to investigate whether advertisers "learned" to shade their bids in the months that followed the disclosure of RPO. In the first test, I used the same regression discontinuity design described above, except that I excluded the months immediately following the disclosure. In doing so, I allow advertisers to take up to four-and-a-half months following the disclosure to shade their bids, lowering CPMs.[401]

203. As shown in Table 4, the results of this analysis do not find evidence that advertisers reduced their bids in the months that followed the announcement of RPO. Only two of the forty estimates are statistically significant at the 10% level, and none are significant at the 5% level.[402] Combined with the fact that estimates range from negative to positive, this

inference approach I use) I find that 17%, 33%, 23%, 23%, 23%, 20%, 20%, and 8%, respectively, are statistically significant at the 5% level. Similarly, I find that 25%, 44%, 33%, 37%, 34%, 27%, 32%, and 27% are statistically significant at the 10% level. For a well-known example of a study that demonstrated this same problem in a different context, see Bertrand, Marianne, Esther Duflo, and Sendhil Mullainathan, "How Much Should We Trust Difference-in-Differences Estimates?," *Quarterly Journal of Economics*, Vol. 119, No. 1, 2004, at 249 ("Most papers that employ Difference-in-Differences estimation (DD) use many years of data and focus on serially correlated outcomes but ignore that the resulting standard errors are inconsistent. To illustrate the severity of this issue, we randomly generate placebo laws in state-level data on female wages from the Current Population Survey. For each law, we use OLS to compute the DD estimate of its 'effect' as well as the standard error of this estimate. These conventional DD standard errors severely understate the standard deviation of the estimators: we find an 'effect' significant at the 5 percent level for up to 45 percent of the placebo interventions.").

[401] The "half" month refers to the fact that the disclosure occurred in mid-May 2016.

[402] I note that, when computing many estimates, chance alone makes it likely that some of the estimates will be statistically significant. For example, if one were to perform 10 independent statistical tests, one would expect one estimate to be statistically significant at the 10 percent level due to chance. This is what economists and statisticians

indicates that there is no evidence that advertisers adjusted to the announcement in the subsequent months by reducing their bids. Again, this fact indicates that Google did not earn additional net revenue or profit because of the alleged deception about RPO.

Table 4
Estimated Shift in CPM from Google's Disclosure of RPO
With Potential Delay in Learning

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
# of Months Included	24	24	20	20	16	16	12	8
Assumed Functional Form (Quadratic or Linear)	Quad.	Lin.	Quad.	Lin.	Quad.	Lin.	Lin.	Lin.
No Delay								
Estimated effect of disclosure	0.02	-0.09	0.06	-0.07	0.06	-0.02	0.01	0.02
P-value from a two-sided test of statistical significance (t-statistic based)	[0.813]	[0.208]	[0.404]	[0.25]	[0.554]	[0.589]	[0.95]	[0.453]
1 Month Delay								
Estimated effect of disclosure	0.03	-0.10	0.11	-0.09	0.15	-0.04	0.03	0.06
P-value from a two-sided test of statistical significance (t-statistic based)	[0.745]	[0.17]	[0.235]	[0.255]	[0.164]	[0.564]	[0.61]	[0.063]
2 Month Delay								
Estimated effect of disclosure	-0.02	-0.11	0.11	-0.12	0.13	-0.06	-0.01	0.09
P-value from a two-sided test of statistical significance (t-statistic based)	[0.783]	[0.152]	[0.22]	[0.14]	[0.389]	[0.481]	[0.828]	[0.129]
3 Month Delay								
Estimated effect of disclosure	-0.09	-0.12	0.07	-0.15	0.12	-0.10	-0.08	0.09
P-value from a two-sided test of statistical significance (t-statistic based)	[0.333]	[0.133]	[0.592]	[0.082]	[0.472]	[0.302]	[0.439]	[0.148]
4 Month Delay								
Estimated effect of disclosure	-0.14	-0.12	-0.02	-0.15	0.07	-0.13	-0.10	-0.01
P-value from a two-sided test of statistical significance (t-statistic based)	[0.295]	[0.227]	[0.813]	[0.146]	[0.731]	[0.173]	[0.357]	[0.967]

Notes: [1] The dependent variable is the natural log of CPM. [2] The test of statistical significance is the two-sided empirical p-value from a permutation test. [3] CPM is seasonally adjusted using data from 2014 to 2019. [4] Data are limited to U.S. users, Open Auctions, and exclude app, video, tv, ctv, game console, and "other" device type transactions. [5] May 2016 is excluded from the sample, since the mechanics of RPO were publicly disclosed midway through that month.
Source: AdX Data (GOOG-AT-MDL-DATA-000066537 - GOOG-AT-MDL-DATA-000481994)

204. For the second test, I examine whether the rate of CPM change over time (rather than the level of CPM) declined following Google's disclosure of RPO, relative to the months before the disclosure. I do so based on the same linear fit specification I used for the regression discontinuity analysis in Table 3. The test asks whether the estimated "slope," or rate of monthly change in CPM, changed after Google disclosed RPO in May 2016.

refer to as the problem of multiple inference, or multiple testing. See, e.g., Anderson, Michael L., "Multiple Inference and Gender Differences in the Effects of Early Intervention: A Reevaluation of the Abecedarian, Perry Preschool, and Early Training Projects," *Journal of the American Statistical Association*, Vol. 103, No. 484, 2008, pp. 1481-95.

Evidence that this slope decreased following the disclosure would be consistent with the plaintiffs' theory of harm (that the disclosure led to shading). On the other hand, evidence that the slope did not change or increased is inconsistent with plaintiffs' theory and indicates Google did not profit from the alleged deception.

205. Results are shown in Table 5. Estimates are small and range from negative 0.004 to 0.019. None of the estimates are statistically significant. Collectively, these results indicate there is no evidence that advertisers started shading following the disclosure of RPO.[403,404]

Table 5
Estimated Difference in the Rate of Change of CPM following Google's Disclosure of RPO
An Empirical test of whether learning resulted in a reduction in CPM

Model	(1)	(2)	(3)	(4)	(5)
# of Months included	24	20	16	12	8
Assumed Functional Form	Lin.	Lin.	Lin.	Lin.	Lin.
Estimated difference in time trend after the disclosure of RPO[1]	0.003	-0.003	-0.001	-0.004	0.019
P-value from a two-sided test of statistical significance (t-statistic based)[2]	[0.833]	[0.827]	[0.964]	[0.817]	[0.188]

Notes: [1] Estimates measure the change in the time trend (i.e., the rate of change or slope) of the natural log of CPM following the May 16, 2016 disclosure of the mechanics underlying RPO. [2] The test of statistical significance is the two-sided empirical p-value from a permutation test, which measures the fraction of possible t-statistics that are at least as extreme, in absolute value, as the t-statistic from the estimated effect of the actual May 16, 2016 disclosure. It comes from estimating "effects" of placebo policies using time periods of the same length throughout the full sample. To mirror the non-placebo regressions, the middle month is excluded from each regression. [3] Estimates come from the same specification as that used in Table 3. [4] Negative estimates are consistent with learning after the disclosure, as it suggests that bids and CPMs decline more after the disclosure than they did before the disclosure. [5] CPM is seasonally adjusted using data from 2014 to 2019. [6] Data are limited to US users, Open Auctions, and exclude app, video, tv, ctv, game console, and "other" device type transactions. [7] May 2016 is excluded from the sample, since the mechanics of RPO were publicly disclosed midway through that month.
Source: AdX Data (GOOG-AT-MDL-DATA-000066537 - GOOG-AT-MDL-DATA-000481994).

206. In summary, the results above are inconsistent with the assertions made by the plaintiffs, Professor Weinberg, and Mr. Andrien. My results indicate that the disclosure of RPO did

[403] The test of statistical significance is based on the same permutation-based approach as in Table 3, which is based on the fraction of possible t-statistics that are more extreme that the t-statistic of the actual estimate. The resulting empirical p-values are similar if the test is instead based on coefficients rather than t-statistics. The corresponding p-values for Columns (1) – (5) of Table 5 are 0.792, 0.788, 0.964, 0.8, and 0.484, respectively.

[404] The largest negative estimate—that is, the estimate that is most consistent with hypothesis that advertisers did not learn to shade until the months after the disclosure—is -0.004. Taken at face value, that estimate, which is not statistically different from zero, suggests that, following the disclosure of RPO, advertisers reduced their bids only 0.4 percent more per month than they did before. Thus, even that estimate is inconsistent with the plaintiffs' theory of harm.

not cause a decline in advertiser bids and CPM.

207. This conclusion is consistent with the analysis in Section II.B regarding how advertisers, their advertiser agencies, and their ad buying tools generally learn, evaluate performance, and determine how to adapt optimally to changes in the auction environment, and how they do so regardless of whether they know the details of optimization features. These the results are inconsistent with plaintiffs' theory that announcements or disclosures about optimization features are a primary driver of advertiser decision-making.

208. For all of these reasons, I conclude that the alleged deception about RPO did not generate additional profit for Google. According to Mr. Andrien's framework, the absence of additional profit implies that the appropriate civil penalty for the alleged RPO-related deception is zero.

209. Despite the evidence indicating that the alleged deception about RPO did not generate additional profit for Google, I also perform a second analysis that provides a conservative estimate of Google's incremental profits from the alleged deception. This analysis assumes (contrary to the evidence discussed above) that the alleged nondisclosure of RPO prevented advertisers from optimally adjusting their bidding behavior. As described in Appendix D, I estimate the degree to which advertisers would have shaded their bids absent the alleged deception about RPO and calculate that, under plaintiffs' theory, Google would have earned an additional $2,049,015 in profit in the plaintiff States as a result of the alleged deception about RPO. To be clear, I consider that amount to exceed any benefits that Google may have received from such alleged deception because it assumes that announcements relating to optimization features are a primary driver of advertiser behavior. That assumption is inconsistent both with how advertisers generally behave, as discussed in Section II.B, and with the evidence indicating that average CPM in AdX did not decline after the public disclosure of RPO.

B. Dynamic Revenue Sharing

210. Prior to the introduction of sell-side Dynamic Revenue Sharing ("DRS") in August 2015, AdX generally kept as a "revenue share" approximately 20% of gross revenues (i.e., the

revenue it receives from bidders) for Open Auction transactions"[405] To win an AdX auction, a net bid (i.e., the advertiser's bid net of AdX's revenue share) had to exceed the other net bids in the auction, and it also had to exceed the reserve price.

211. It was possible for the highest bid in an AdX auction to exceed the reserve price on a gross basis, but fall below that reserve price on a net basis. In such situations, the high bidder would not win the impression, and the auction would not clear.[406] Suppose, for example, that the reserve price was $1.80 and the AdX revenue share was 20 percent. If the high bidder offered $2.00 for the impression, its net bid would be $1.60 (80 percent of $2.00) and the impression would not be sold because the highest net bid of $1.60 would fall below the $1.80 reserve price. For the AdX auction to clear, the high bid would need to be at least the reserve price divided by the portion of the revenue share going to the publisher (e.g., 80%).[407] In this example, the high bid would need to be at least $2.25 (= $1.80 / 0.80) to clear the reserve price.

212. Google introduced DRS to increase publishers' and Google's revenues, and to help advertisers bidding into AdX win more impressions, by dynamically changing the AdX revenue share to clear more AdX auctions.[408]

213. Google implemented three major versions of DRS, with each newer version replacing the earlier one.

- *DRS v1* was launched in August 2015 and "decreased Google's revenue share to grow revenue overall."[409] Google's reduced revenue share permitted more

[405] Declaration of [redacted], August 4, 2023, GOOG-AT-MDL-008842393 ("August 4, 2023 [redacted] Declaration") at ¶ 29 ("Google's contracts with publishers specify how they will share revenue when AdX wins an impression. Up to at least December 2021, Google's standard rate was 20% of the clearing price in the AdX open auction. Prior to DRS, a publisher would receive the same, fixed revenue share on each impression that AdX won. With DRS, the AdX revenue share could change on a per-impression basis, as long as each publisher received at least their agreed-upon share of the revenue [redacted] in aggregate over the contractual billing period.").

[406] Instead, the impression could be won by another DFP line item or go unsold.

[407] See, e.g., Weinberg Report at ¶ 190.

[408] See GOOG-DOJ-15130321 at -321 ("DRS is an optimization feature that increases publisher and Google revenue by dynamically changing the AdX sell-side revenue share so that more auctions end with a winning buyer.").

[409] GOOG-DOJ-15130321 at -321; see also Defendant Google LLC's First Amended Responses and Objections to Plaintiffs' Third Set of Interrogatories, May 24, 2024, at 12 ("Dynamic Revenue Share launched on or about August 20, 2015. DRS v. 2 subsequently launched on or about December 1, 2016. tDRS subsequently launched on or about July 17, 2018.").

net bids to exceed the reserve price and more auctions to clear.[410] DRS v1 could reduce the AdX revenue share to as low as zero.[411]

- Google launched *DRS v2* in December 2016.[412] With DRS v2, AdX "decreas[ed] and increas[ed] the Google share on different impressions, to increase the number of AdX auctions with a winning buyer while always achieving the publisher's contracted revenue share."[413] Testimony and internal Google documents indicate that DRS v2 made publishers better off, relative to a world without DRS.[414]
- Google launched *truthful DRS* ("tDRS") in July 2018.[415] While DRS v1 and DRS v2 adjusted AdX's revenue share after receiving buyers' bids, truthful DRS adjusted AdX's revenue share before sending bid requests to AdX buyers.[416] Although Mr. Andrien asserts that "certain aspects of tDRS were

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[410] To continue my earlier example, assuming that the reserve price was $1.80 and the high bid was $2.00 DRS v1 might reduce Google's revenue share to 10%, in which case the net bid would be $1.8 (i.e., $2 minus the revenue share of $0.20) so that: (i) the advertiser would pay $2.00 (i.e., its bid) and (ii) the publisher would receive $1.80 (i.e., the floor price).

[411] See Email from [redacted] (Google), "Re: AdX Dynamic Revenue Share – requesting VP Launch Approval by email," December 4, 2014, GOOG-DOJ-13330569 at -572 ("DRS can clear queries in the larger 0-20% [AdX rev share] range."); August 4, 2023 [redacted] Declaration at ¶ 31 ("In this initial version of DRS, the minimum revenue share applied was 0%.").

[412] See Defendant Google LLC's First Amended Responses and Objections to Plaintiffs' Third Set of Interrogatories, May 24, 2024, at 12 ("Dynamic Revenue Share launched on or about August 20, 2015. DRS v. 2 subsequently launched on or about December 1, 2016. tDRS subsequently launched on or about July 17, 2018.").

[413] GOOG-DOJ-04937543 at -543. Under DRS v2, the minimum revenue share applied was 0% and the maximum was 40%. AdX tracked the payments by each buyer to each publisher using "accounts" to ensure that, while the AdX revenue share applying to an individual impression could be higher or lower, AdX received its standard revenue share on average over all impressions for a given advertiser/publisher pair. See GOOG-DOJ-13207875 at –875, -879-881.

[414] See, e.g., August 4, 2023, [redacted] Declaration at ¶ 33 (explaining that "[p]rior to launching DRS v2, Google conducted experiments [redacted] A condition of launching DRS v2 was that it accomplish[ed] these benefits as opposed to solely shifting transactions from remnant line items (including header bidding line items) to AdX."); GOOG-DOJ-13235100 at -101-102 (showing that, compared to what would have occurred with "no-DRS", DRS v2 increased overall publisher revenues across AdX and other remnant inventory [redacted]).

[415] See GOOG-DOJ-15130321 at -321 (July 2018 update notes "We launched a new DRA model (tDRS)"); GOOG-DOJ-13949282 at tab "Q3Q4 2018", row 7 (AdX Truthful Dynamic Revenue Share launch date noted as July 17, 2018); see also Defendant Google LLC's First Amended Responses and Objections to Plaintiffs' Third Set of Interrogatories, May 24, 2024, at 12 ("Dynamic Revenue Share launched on or about August 20, 2015. DRS v. 2 subsequently launched on or about December 1, 2016. tDRS subsequently launched on or about July 17, 2018.").

[416] See GOOG-DOJ-15130321 at -321 ("With tDRS we determine Google's revenue share before seeing buyer bids.").

misleading to publishers,"[417] he does not propose any civil penalties related to tDRS.

214. The DRS program was discontinued once Google moved to a unified first price auction in September 2019.[418]

1. DRS v1

215. Relying on Professor Weinberg, Mr. Andrien contends that, with DRS v1, "AdX did not run a true second price auction."[419] Professor Weinberg opines that "DRSv1 is a dirty second-price auction" because, when DRS v1 lowered the AdX revenue share to clear an auction on AdX, "DRS v1 charges the highest bidder their bid."[420] Professor Weinberg also theorizes that (i) "[p]ublishers would have set different reserve prices to maximize their revenues had Google revealed DRS v1;"[421] and (ii) advertisers would have shaded (i.e., lowered) their bids "to maximize their payoffs had Google revealed DRS v1."[422]

216. However, neither Mr. Andrien nor Professor Weinberg considers the evidence of how advertisers and publishers actually behave. As described in Section II.B, as a general rule, both advertisers and publishers continually monitor performance and run experiments and other tests to optimize their strategies, often relying on other experienced intermediaries —such as advertising agencies, ad buying tools, and SSPs—to help them achieve the best results. Neither Mr. Andrien nor Professor Weinberg has provided any evidence that advertisers or publishers (or their intermediaries) focus on disclosed details about optimization features when developing and implementing their strategies.

217. As a result, the evidence indicates that advertisers, with assistance from their ad buying tools and advertising agencies, would have continued to monitor returns, perform tests,

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[417] See Andrien Report at ¶ 42.

[418] See GOOG-DOJ-14037639 at -641 ("For the first iteration [of the unified first price auction], DRS (dynamic revenue sharing) and RPO (reserve price optimization) is out of scope."); August 4, 2023 [redacted] Declaration at ¶ 36 ("DRS was discontinued in September 2019, following the launch of the Unified First Price Auction.").

[419] Andrien Report at ¶ 38.

[420] Weinberg Report at ¶ 195.

[421] Weinberg Report at ¶ 219.

[422] Weinberg Report at ¶ 228 ("By not revealing DRSv1 to the advertisers, Google made material gains. This is because if advertisers were to shade their bids, which is the natural bidding behavior in a non-truthful auction like DRSv1, this would lead to less revenue for both AdX and publishers. However, advertisers likely did not shade their bids, since Google never publicly revealed DRSv1.").

and optimize their strategies to maximize returns regardless of whether DRS v1 was disclosed. Moreover, if some advertisers were uninterested or unskilled at monitoring returns or optimally adapting, there is no evidence to suggest that such parties would respond with greater interest or skill to disclosures about DRS v1. Hence, advertisers' strategies in the actual world were likely similar to their strategies in the but-for world where DRS v1 was disclosed. Similarly, as described in Section II.B, regardless of whether DRS v1 was disclosed, publishers would monitor their returns and optimize their price floors based on the feedback they were constantly receiving as they participated in the auctions. Because both advertisers and publishers were likely engaging in the same strategies in both the actual and but-for worlds, Google's profits were likely the same in the actual and but-for worlds.

218. For this reason, I conclude that the alleged deception about DRS v1 did not generate additional profit for Google. According to Mr. Andrien's framework, the absence of additional profit due to the alleged deception implies that the appropriate civil penalty for the alleged deception about DRS v1 is zero.

219. Despite the evidence indicating that the alleged deception about DRS v1 did not generate additional profit for Google, I also perform a second analysis that provides a conservative estimate of Google's incremental profits from the alleged deception assuming (contrary to the evidence discussed above) that the alleged nondisclosure of DRS v1 prevented advertisers from optimally adjusting their bidding behavior. As described in Appendix D, I estimate the degree to which advertisers would have shaded their bids absent the alleged deception about DRS v1 and calculate that, under plaintiffs' theory, Google would have earned an additional $1,339,893 in profit in the plaintiff States as a result of the alleged deception about DRS v1.[423] To be clear, I consider that amount to exceed any benefits that

[423] I assume, as does Mr. Andrien, that transactions from August 2015 to November 2016 would potentially be affected by the alleged deception about DRS v1. This range is conservative because Google disclosed DRS v1 on August 4, 2015, prior to the full launch of DRS v1 on August 20, 2015. See GOOG-AT-MDL-C-000035251 at -251 (Google Help Center post with filename of "web_152039_version_47_*2015-08-04*__11_33_52.pdf", explaining that "[t]he Ad Exchange auction closing price is determined as the greater of the second-highest net bid in the Ad Exchange auction or the reserve price applied to that impression. *In some cases, the auction may close at a price lower than the reserve price applied, due to auction optimizations.* Sellers are paid the Ad Exchange closing price, *net of Google's revenue share*, but will receive, subject to the terms governing their use of Ad Exchange, no less than the min CPM applied to the auction." (emphases added)); Defendant Google LLC's First Amended Responses and Objections to Plaintiffs' Third Set of Interrogatories, Responses to Interrogatory No. 6 ("Dynamic Revenue Share launched on or about August 20, 2015.").

Google may have received from such alleged deception because it assumes that announcements about optimization features are a primary driver of advertiser behavior. That assumption is inconsistent with how advertisers generally behave (as discussed in Section II.B).

2. DRS v2

220. Mr. Andrien asserts that the alleged deception concerning DRS v2 served to "mislead both advertisers and publishers regarding how much they are paying or paid out, prevented them from employing optimal bidding strategies, and obscured feedback to advertisers."[424] In doing so, Mr. Andrien relies on Professor Weinberg, who theorizes that, if Google had fully disclosed all aspects of DRS v2, then "no advertiser would bid in the dynamic region, and therefore DRS v2 would be equivalent to no DRS. That is, exactly the same advertisers would win exactly the same impressions and pay exactly the same amount and the entire DRSv2 program would be obviated."[425]

221. In theorizing that advertisers would have bid differently if they knew all the details of DRS v2, Mr. Andrien and Professor Weinberg fail to acknowledge that, before launching DRS v2, Google disclosed that AdX revenue shares on any given transaction could be higher or lower than the contract rate.[426]

222. That disclosure, combined with how advertisers generally monitor and optimize returns over time with help from their ad buying tools and advertising agencies, indicates that advertisers likely behaved the same way in the actual world as they would have behaved

[424] Andrien Report at ¶ 42 ("I understand that some aspects of DRSv2 were misleading to advertisers and publishers based, in part, on Google's omissions in clearly disclosing the concept of debt with DRSv2, which mislead both advertisers and publishers regarding how much they are paying or paid out, prevented them from employing optimal bidding strategies, and obscured feedback to advertisers.").

[425] Weinberg Report at ¶ 226(a); see also *id.* at ¶ 226(b) ("[T]he best [advertisers] can do is to bid truthfully outside the dynamic region and avoid the dynamic region entirely."). Professor Weinberg does not appear to claim that the alleged deception about DRS v2 impacted publisher behavior. Moreover, his claim that, if disclosed, "DRSv2 program would be obviated," *id.* at ¶ 226(a), seems to suggest that he believes that disclosure would not have caused publishers to change how they set floor prices. See *id.* at ¶ 226(a).

[426] See GOOG-DOJ-14718514 at -514 ("We would like to allow AdX publishers to control whether they would like to use 1) fixed rev share on a per query basis or 2) dynamic rev share with average rev share at 80%. Opt-out control is a prerequisite for rolling out AdX dynamic rev share v2.… AdX publishers will be able to decide among a) opt out of dynamic rev share and use fixed Rev share 2) opt in dynamic rev share."); see also GOOG-DOJ-15130321 at -326 ("You may choose to opt-out of revenue share based optimizations in the AdX Ul. If you opt-out we will apply your contracted revenue share to every Open Auction query and you will not benefit from the increased revenue from this optimization.").

had Google disclosed even more details about DRS v2. Accordingly, there is no reason to believe that Google profited from the alleged deception about DRS v2. Therefore, under Mr. Andrien's framework, the appropriate civil penalty for such alleged deception is zero.

223. Despite the evidence indicating that the alleged deception about DRS v2 did not generate additional profit for Google, I also perform a second analysis that provides a conservative estimate of Google's incremental profits from the alleged deception assuming (contrary to the evidence discussed above) that the alleged nondisclosure of DRS v2 prevented advertisers from optimally adjusting their bidding behavior. [427]As described in Appendix D, I estimate the number of incremental transactions in the "dynamic region," which occur due to the alleged deception according to Professor's Weinberg theory.[428] I estimate that Google would have earned an additional $3,975,659 in profit in the plaintiff States as a result of the alleged deception about DRS v2. To be clear, I consider that amount to exceed any benefits that Google may have received from such alleged deception because it assumes that announcements about optimizations are a primary driver of advertiser behavior. That assumption is inconsistent with how advertisers generally behave (as discussed in Section II.B).

C. Project Bernanke

224. In late 2013, Google Ads implemented Project Bernanke ("Bernanke") to optimize its bids into AdX.[429] Bernanke reduced or dropped the second bid that Google Ads submitted into

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[427] Weinberg Report at ¶ 226(a) ("If all advertisers responded optimally to DRSv2, no advertiser would bid in the dynamic region, and therefore DRSv2 would be equivalent to no DRS" (original emphasis omitted)).

[428] Weinberg Report at ¶ 226(a) ("This increase in AdX revenue is only possible if transactions are cleared in the dynamic region, and every transaction cleared in the dynamic region necessarily involves an advertiser paying more than their value for an impression, and therefore suffering decreased payoff in comparison to no DRS.").

[429] GOOG-AT-MDL-009644018 at cell D2 ("Original Dynamic Revshare [buy-side DRS] launch was designed to reduce GDN buyside margin in AdX auctions [redacted] down to potentially 0% to win more auctions. With this project, we are doing a little quantitative easing on the AdX, a la Bernanke … This is net-positive for GDN, GDN's advertisers, and publishers. GDN wins more auctions and generates more revenue at the same average [redacted] revshare; GDN's advertisers win more auctions and get greater click/conversion volume; and AdX publishers enjoy higher match rate and revenue."); see also GOOG-DOJ-13469175 at -176 ("Project Bernanke involves reducing the second price and increasing the first price of the two bids submitted by GDN to the AdX auction in such a way that publishers receive fair payout [e.g., GDN margin remains constant] and GDN profit is maximized."). It is also worth noting that the Bernanke algorithm was calibrated using data that were available to other bidders into the AdX auction. *Id.* at -176 ("It is important to note that in this entire process, we only use information about the GDN bid and the GDN price paid on queries won by GDN. In other words, we do not use any AdX buyer information."); GOOG-DOJ-06842351 at -359 ("We respect GDN-AdX firewall: we only utilize GDN data to optimize bidding strategy. Any AdX buyer can do this.").

the AdX auction, which enabled Google Ads to reduce its payments to publishers for those impressions and then increase the top Google Ads bid on other impressions that it predicted were unlikely to otherwise clear.[430] These additional impressions created the possibility of additional clicks or other actions valued by advertisers. Bernanke was similar to programs used by other ad buying tools.[431]

225. Under the initial version of Bernanke, which launched in November 2013,[432] Google Ads targeted an average revenue share on a per publisher basis.[433] In August 2015, Google launched Global Bernanke (also known as Bell v.1), which sought to maintain the same average margin across all publishers, while allowing that margin to vary for individual publishers.[434] In addition, between May 2016 and September 2019, a "truthful" version of Bernanke applied to Google Ads advertisers who were using autobidding.[435] Because that version of Bernanke was "truthful," advertisers using autobidding would have had no

[430] GOOG-DOJ-13469175 ("Bernanke involves reducing the second price and increasing the first price of the two bids submitted by GDN to the AdX auction").

[431] [redacted]

[432] See GOOG-AT-MDL-009644018 at cell C2.

[433] August 5, 2023 [redacted] Declaration at ¶ 9.

[434] August 5, 2023 [redacted] Declaration at ¶ 10.

[435] See GOOG-DOJ-AT-02467209 at -209 (indicating that the "truthful" version of Bernanke would "charge the minimum price needed to win the query. No change for non-CO ads. … We propose that for CO [Conversion Optimizer] advertisers (tCPA, fixed CPA, ROAS) gTrade should charge the minimum price to win the query, which makes the traffic look like regular second price auction.").

incentive to modify their bids even if Bernanke had been disclosed to them.

226. Mr. Andrien asserts that advertisers "would have shaded their bids in order to get higher payoffs had they known about Projects Bernanke and Global Bernanke."[436] In doing so Mr. Andrien relies on Professor Weinberg, who likewise contends that "[a]dvertisers would have shaded their bids to maximize their payoff had they known about Projects Bernanke and Global Bernanke."[437]

227. Mr. Andrien also asserts that "all publishers likely would have changed their behavior had they known about Projects Bernanke and Global Bernanke by raising their reserve prices in order to maximize their revenue."[438] Again, in doing so, Mr. Andrien relies on Professor Weinberg, who claims that "[p]ublishers would have raised their reserve prices to maximize their revenue had they known about Projects Bernanke and Global Bernanke."[439] Mr. Andrien's and Professor Weinberg's theory wrongly assumes that Google Ads advertisers commonly bid on a CPM basis, when only a very small percentage of those advertisers did so. In fact, [redacted] percent of Google Ads advertisers bid on a CPC or CPA basis.[440]Those advertisers relied on Google Ads to convert those bids into CPM bids that AdX could compare to CPM bids from other buyers, and Bernanke did not change that.[441] Furthermore, there is no evidence that advertisers knew the details of how the conversion algorithm operated and used that knowledge to inform their bidding strategies *before* Bernanke. As a result, there is no basis to assume that advertisers would have altered their bidding strategies had Google disclosed Bernanke sooner and, thus, no basis to conclude that Google's profit was higher in the actual world than it would have been in the but-for world without the alleged deception about Bernanke.[442] It is far more

[436] Andrien Report at ¶ 46.

[437] Weinberg Report at ¶ 258, heading for Section VIII.E 2.

[438] Andrien Report at ¶ 46.

[439] Weinberg Report at ¶ 248, heading 3, for Section VIII.C.3.

[440] Calculation based on Google Ads Dataset (for data sources and calculations, see workpaper "Google Ads Impressions by Advertiser Payment Model.xlsx").

[441] See 30(b)(1) [redacted] (Google) Deposition at 44:10-13, 45:12-16 ("Bernanke did not change how AdWords charged advertisers. What changed was how we would bid into the AdX auction in order to further improve advertiser value.… AdWords continued to charge advertisers based on the runner up, which -- which is what the second-price auction that AdWords was running was doing prior to Bernanke too and it continued to even after Bernanke was launched.").

[442] For the same reason, Bernanke could not have "caused advertisers to pay the price of the actual second-highest bid

likely that, if Bernanke had been disclosed, Google Ads advertisers would have continued to rely on Google Ads to formulate optimal bids into AdX for them in the same way that they did in the actual world.

228. Even for the few Google Ads advertisers who bid on a CPM basis, Mr. Andrien's and Professor Weinberg's theory fails to account for the fact that, as a general matter and as described in Section II.B, advertisers and publishers learn over time by continually evaluating returns and performing experiments and optimizing accordingly. Moreover, economic reasoning indicates that, even if some advertisers or publishers were uninterested or unskilled at monitoring returns or optimally adapting, such parties would likely be just as uninterested or unskilled at monitoring and optimally responding to disclosures about Bernanke. As a result, advertisers and publishers likely responded to Bernanke in the actual world in the same way as they would have if Bernanke had been disclosed. This fact implies that Google was unlikely to have benefitted from the alleged deception about Bernanke and that the appropriate penalty under Mr. Andrien's framework would be zero.

229. Despite the evidence indicating that the alleged deception about Bernanke did not generate additional profit for Google, I also perform a second analysis that provides a conservative estimate of Google's incremental profits from the alleged deception assuming (contrary to the evidence discussed above) that the alleged nondisclosure of Bernanke prevented advertisers from optimally adjusting their bidding behavior. As described in Appendix D, I estimate the degree to which advertisers in the but-for world would have shaded their bids and calculate that, under plaintiffs' theory, Google would have earned an additional $14,359,456 in profit in the plaintiff States as a result of the alleged deception about Bernanke. To be clear, I consider that amount to exceed any benefits that Google may have received from such alleged deception because it assumes that announcements about

instead of the third-highest bid" and could not have "deceived advertisers into paying the difference between the third and second highest bid directly into Google's pool." FAC ¶¶ 315, 553. Because the vast majority of Google Ads advertisers pay for actions, rather than impressions, the revenue share retained by Google Ads is calculated over the entire set of impressions that lead to a click rather than a single impression as posited by plaintiffs. See GOOG-AT-MDL-C-000009970 at -973 ("GDN … can not achieve 14% on every query because we pay per impression and receive revenue per click. Aim for 14% margin in expectation (over a set of queries)."). I am not aware of any evidence that Bernanke delivered clicks to advertisers in a way that did not meet the constraints imposed on the campaign by the advertiser, including the maximum cost per action such as CPC.

optimizations are a primary driver of advertiser behavior. That assumption is inconsistent with how advertisers generally behave (as discussed in Section II.B).

D. Alchemist

230. With Google's transition to a unified first price auction in the fall of 2019, Project Bernanke was replaced by a successor program known as "Alchemist" or "First Price Bernanke." Mr. Andrien asserts that "[u]nder First Price Bernanke, I understand that GDN continued to manipulate advertisers' bids before sending them to AdX."[443]

231. As with alleged deception about the programs discussed above, in assessing whether Google benefitted from the alleged deception regarding Alchemist, it is important to consider the underlying economics regarding how advertisers and publishers behave. The evidence in Section II.B indicates that publishers and advertisers make decisions primarily by monitoring returns and adjusting and learning over time based on feedback from actual auctions, rather than by focusing on public announcements. As a result, there is no reason to believe that the behavior of the auction participants or the outcomes of auctions would be different if Google Ads had revealed it was using Alchemist or any similar bid optimization program.

232. Moreover, Professor Weinberg acknowledges that one component of Alchemist is "a bid optimizer for GDN users that makes their participation in AdX's first-price auction truthful."[444] Professor Weinberg defines an auction as "truthful" if "each bidder receives the best possible outcome (given the other bidders' bids) by submitting a bid equal to their own value."[445] The "truthfulness" of Alchemist implies that, even if Google had disclosed Alchemist to Google Ads advertisers—and if advertisers focused on these disclosures, rather than on continually monitoring performance and optimizing—advertisers *still would have bid the same way as they did without the disclosure*. It follows that publishers would have no incentive to change their floors as a result of the disclosure.[446]

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[443] Andrien Report at ¶ 47.

[444] Weinberg Report at ¶ 266.

[445] Weinberg Report at ¶ 47.

[446] The logic for why Bernanke could lead publishers to raise their floors in the context of a second-price auction (i.e., to increase the clearing price when Google Ads' high bid wins and other bids are meaningfully lower) does not apply in the context of a first-price auction (where a bidder pays its own bid). As I discussed in Section II.B, publishers'

233. Because neither advertiser nor publisher behavior depended on knowledge of Alchemist, the alleged deception about Alchemist did not increase Google's profits or otherwise benefit Google.

234. Moreover, neither Mr. Andrien nor Professor Weinberg has articulated a theory for, or provided empirical evidence of, how the alleged *deception* regarding Alchemist impacts auction participants. Instead, the evidence provided by Professor Weinberg indicates that Google Ads advertiser-, and by extension publisher-, behavior would be unaffected by the alleged deception. Because neither Mr. Andrien nor Professor Weinberg have articulated a theory for how Google could have benefitted from the alleged deception about Alchemist, they have provided no basis for assessing DTPA civil penalties for such alleged deception under Mr. Andrien's framework.

235. Similarly, neither Mr. Andrien nor Professor Weinberg has articulated a theory for, or provided empirical evidence of, how Alchemist is inconsistent with Google's so-called "equal footing" statement. In particular, neither Mr. Andrien nor Professor Weinberg has asserted that AdX treats bids coming into its auctions differentially because of Alchemist.

236. Because neither Mr. Andrien nor the plaintiffs have articulated a theory for why Alchemist is inconsistent with bidders being on "equal footing," they have provided no basis for assessing how Google could have benefitted from the alleged deception about AdX participants being on "equal footing" while Alchemist was in place.

237. For these reasons, Mr. Andrien has no basis to propose a non-zero DTPA civil penalty for the alleged deception about Alchemist.

E. Facebook Network Bidding Agreement

238. The plaintiffs contend that, "[s]tarting at least as early as 2019, Google represented that all bidders in Google's exchange compete on an equal footing."[447] According to the plaintiffs, this statement was deceptive because Google's Network Bidding Agreement (NBA) with

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decisions about floor prices are inherently the result of a *data driven* process where floors are adapted to the *observed* bidding behavior of advertisers. As an illustration, I note that Google's RPO feature selected publisher-specific revenue maximizing floor prices using data on the bids on a publisher's inventory from the previous day. GOOG-DOJ-13199480 at -483. Plaintiffs have not demonstrated—or even claimed—that, had they known about Alchemist, publishers would have changed their floors in a way that would reduce Google's profit.

[447] FAC ¶ 586.

Facebook[448] gave Facebook advantages that no other Open Bidder enjoyed.[449] Specifically, the plaintiffs claim that, under the NBA, Facebook received several secret advantages in Open Bidding auctions,[450] including (i) volume discounts[451]; (ii) longer timeout periods[452]; (iii) the ability to pay publishers directly[453]; (iv) guaranteed match rates[454]; and (v) assistance in detecting spam.[455] In addition, Mr. Andrien claims that the NBA advantaged Facebook by (vi) granting it access to proprietary Google data.[456] Mr. Andrien summarizes the plaintiffs' position by asserting that "Google provided Facebook with advantages that were not available to other auction participants, and because of the confidentiality of the NBA, such advantages were not disclosed to other participants."[457] But neither Mr. Andrien nor Professor Weinberg explain or quantify how the alleged deception about the NBA generated benefits to Google. Indeed, they do not provide any evidence that the alleged advantages even existed.

239. There are three primary reasons why Google's incremental net revenues and profits from the alleged "equal footing" deception with respect to the NBA were zero.

240. *First*, consider the number of U.S. web display transactions won by Facebook on Google's

[448] This "Network Bidding Agreement" was executed on September 28, 2018. See GOOG-TEX-00144513 at -543. Facebook's advertising monetization platform was formerly known as the Facebook Audience Network, or "FAN." As the result of Facebook's rebranding as Meta in late 2021, FAN is now known as the Meta Audience Network. See, e.g., "Introducing Meta Audience Network: New Name, Same Partnership with Publishers," *Meta Audience Network Blog*, November 12, 2021, available at https://www.facebook.com/audiencenetwork/resources/blog/introducing-meta-audience-network (last accessed July 25, 2024).

[449] FAC ¶¶ 588-597.

[450] FAC ¶ 590.

[451] FAC ¶ 428 ("Because auction winners are selected based on highest bid after fees, this special, Facebook-only discount allows Facebook to win auctions even when it submits a lower gross bid than its competitors.").

[452] FAC ¶ 429 ("Google also provided Facebook with a speed advantage. Google subjects other marketplaces competing for publishers' inventory in Exchange Bidding to 160 millisecond timeouts.… By comparison, Google nearly doubled timeouts for Facebook, extending them to 300 milliseconds.").

[453] FAC ¶ 430 ("A third advantage was direct billing. Google further induced Facebook to help Google 'kill HB' by letting Facebook have direct billing and contractual relationships with publishers. This term was advantageous to Facebook because Google prohibits other exchanges and networks in Exchange Bidding from having such direct relationships.… The inability to discuss pricing and terms constrains marketplaces' ability to operate and compete. One advertising competitor compared Google's business term to a 'gag order.'").

[454] FAC ¶ 432 ("In the [NBA], Google promised to use 'commercially reasonable efforts' to help Facebook's network recognize the identity of users in publishers' and developers' auctions.").

[455] FAC ¶ 592 ("[Google] provides Facebook information about impressions that are likely targeted to spam, giving Facebook a leg up over competitors who are left paying for such fake and worthless impressions.").

[456] Andrien Report at ¶ 53.

[457] Andrien Report at ¶ 53.

platform. This is the maximum number of auctions that could possibly have been won by Facebook as a result of the "secret" advantages purportedly created by the NBA.[458] Facebook won [redacted] U.S. AdX Open Auction web transactions and [redacted] U.S. Open Bidding web transactions, accounting for [redacted] in advertiser spending (which is [redacted] of AdX and Open Bidding web spending in any given month during that period).[459] As a result, even if one were to believe that the NBA gave Facebook advantages over other bidders, those advantages translated into, at most, [redacted], some of which Facebook likely would have won even if the NBA had been disclosed earlier. This fact suggests that the alleged "advantages" were immaterial, which in turn indicates that neither Facebook nor other bidders would have behaved differently if the NBA had been made public. It follows, then, that Google's profits would be the same in the but-for world as they were in the actual world. As a result, applying Mr. Andrien's framework implies that the DTPA civil penalty for the alleged deception about the NBA would be zero.

241. *Second*, as I explain in Section II.B., bidders continuously evaluate the performance of their strategies based on historical data and experiments and adjust their bids accordingly. As a result, any changes in advertiser bidding behavior due to the alleged advantages in the NBA would have occurred irrespective of whether the NBA was disclosed, and Google did not benefit from the alleged deception concerning the NBA. Thus, under Mr. Andrien's framework, the appropriate DTPA civil penalty for the alleged deception concerning the NBA would be zero.

242. *Third*, the alleged advantages given to Facebook were not economically significant for the reasons described below. The absence of economically significant advantages means that behavior in the but-for world would have been the same as in the actual world, which in turn implies that Google did not benefit from the alleged deception. These facts imply that, under Mr. Andrien's framework, the appropriate DTPA civil penalty would be zero.

243. *Volume Discounts.* The Fourth Amended Complaint incorrectly contends that the volume discounts specified in the NBA meant that Facebook won auctions even when bidding less

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[458] FAC ¶ 435 ("Google not only kept these special advantages for Facebook secret, but also continues to actively misrepresent the terms on which it conducts publishers' auctions.").

[459] Calculations implemented by "FAN.do".

than other demand sources.[460] Executed in September 2018, the NBA provided that Facebook would be charged a 10% revenue share on its first $500 million in spending per year and then pay lower revenue share (5% instead of 10%) on additional spend, with this threshold increasing to $375 million quarterly in September 2021.[461] But the agreement was amended in January 2022 to remove the volume discount provision.[462] Even before that amendment, Facebook never reached the spending thresholds in the original agreement that would have qualified it for a volume discount. As a result, Facebook always paid a 10% revenue share and never received any advantage from the volume discount provisions of the NBA.[463]

244. *Extended Timeout Periods.* The plaintiffs also contend that Google allowed Facebook a longer timeout period (the time within which a bidder must return a bid to participate in an auction) than it afforded to other bidders.[464] But the plaintiffs overlook that, in December 2018 (i.e., three months after the NBA was executed and before Google made any statements about bidders being on an "equal footing"[465]), Google extended the bid timeout for mobile app inventory from 160 milliseconds to 300 milliseconds to *all* bidders, eliminating whatever advantage this provision may have given to Facebook for a brief

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[460] FAC ¶ 428 ("Because auction winners are selected based on highest bid after fees, this special, Facebook-only discount allows Facebook to win auctions even when it submits a lower gross bid than its competitors.").

[461] More specifically, Facebook was required to pay a fee to Google equal to 10 percent of its Gross Spend in connection with the NBA for its first $500 million of Gross Spend, and 5 percent of its Gross Spend after reaching $500 million annual Gross Spend. GOOG-TEX-00144513 at -548. During Phase 3 of the agreement, which was set to commence on the first day of the fourth year of the Term of the agreement, FAN could alternatively achieve the 5 percent rate tier by reaching a Gross Spend of $375 million in any quarter. See *id.* at -549 ("[I]n Phase 3, if Facebook's Gross Spend is $375,000,000 in any Quarter, the next Quarter's Fee will be billed at a flat rate of 5% of Gross Spend; however, if Facebook fails to spend $375,000,000 in the following Quarter, the next Quarter's Fee will be billed at a flat rate of 10% of Gross Spend.").

[462] See GOOG-AT-MDL-B-007255353.

[463] Calculations based on the AdX Data (see Appendix H) and AdMob Data (GOOG-AT-DOJ-DATA-000000001).

[464] FAC ¶ 429 ("Google also provided Facebook with a speed advantage. Google subjects other marketplaces competing for publishers' inventory in Exchange Bidding to 160 millisecond timeouts. Competitors have actively complained that 160ms is not enough time to recognize users in auctions and return bids before they are excluded. By comparison, Google nearly doubled timeouts for Facebook, extending them to 300 milliseconds. These longer timeouts granted by Google were presumably designed to aid FAN in winning more auctions.").

[465] FAC at ¶¶ 586-587 ("Starting at least as early as 2019, Google represented that all bidders in Google's exchange compete on an equal footing. For example, in the Google Ad Manager blog in March 2019, Google represented that it was creating 'a fair and transparent market for everyone.' The representation remains visible and accessible on Google's website today. Similarly, one of Google's webpages explaining how open bidding works (as captured in April of 2020), represented that '[a]ll participants in the unified auction, including Ad Exchange and third-party exchanges, compete equally for each impression.' That webpage continues to make the same claim today.").

period.[466,467]

245. And when Google extended timeouts for all bidders, Facebook's share of in-app gross revenue transacted on AdX and AdMob was [redacted],[468] meaning that any timeout advantage that Facebook might have achieved in the prior quarter was inconsequential.

246. *Direct Billing*. The Fourth Amended Complaint alleges that the NBA benefitted Facebook by allowing it to "have direct billing and contractual relationships with publishers."[469] There is no economic basis for concluding that this purported advantage would have changed advertiser bidding behavior. As a result, there is no basis for an assertion that Google benefitted from the alleged deception. Moreover, it is not possible for any publisher to have been deceived about Facebook's direct billing because any publisher that used Facebook would know that it was being billed directly by Facebook.

247. *Improved Match Rates*. The plaintiffs allege that, in the NBA, "Google promised to use "'commercially reasonable efforts' to help Facebook's network recognize the identity of users in publishers' and developers' auctions."[470] This provision ensured that Google would provide cookie matching services in connection with web transactions.[471]

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466 See GOOG-DOJ-13220040 at -040. The reason for the extension was that other header bidding solutions gave longer timeouts to bidders than Open Bidding gave to its bidders, placing Open Bidding at a competitive disadvantage. See *ibid.* ("Our current RTB Timeout is 120ms for Authorized Buyers and 160ms for Exchange Bidders. This puts us at a disadvantage, [redacted] … For app in particular, where interstitials are usually pre-fetched and cached, it makes the most sense to increase the deadline to something industry standard. With this launch, we will increase all app traffic to 300ms for Authorized Buyers and Exchange Bidders.").

467 While the launch did not apply to web inventory, as discussed above, Facebook bought very little web inventory since November 2019, and it stopped buying web inventory altogether in April 2020. See "Facebook will shut down Facebook Audience Network's mobile web arm," *Digiday*, February 5, 2020, available at https://digiday.com/media/facebook-plans-shut-facebook-audience-networks-mobile-web-arm/ (last accessed July 25, 2024).

468 [redacted] Calculations based on the AdX data (see Appendix H) and the AdMob data (GOOG-AT-DOJ-DATA-000000001).

469 FAC ¶ 430.

470 FAC ¶ 432. In the NBA, Google committed to use commercially reasonable efforts to ensure an 80% match rate for apps and 60% match rate on the Web. See GOOG-TEX-00144513 at -544. The NBA defines "Match Rate" as the number of bid requests for which Facebook "recognizes the End User" (i.e., can match the request to the information that Facebook has on users of its O&O properties), divided by the total number of bid requests that Google sends to Facebook. See *ibid*. Plaintiffs allege that "Google provides Facebook an advantage in match rates, helping Facebook recognize users more easily, and also provides Facebook information about impressions that are likely targeted to spam, giving Facebook a leg up over competitors who are left paying for such fake and worthless impressions. Given these advantages (as well as the other advantages provided to Facebook as described above), other participants are not competing equally for each impression." FAC ¶ 592.

471 See GOOG-AT-MDL-003595296 at -299 (noting that, when "FAN receives a bid request from Google" in "web,

248. As an initial matter, Mr. Andrien has not provided any evidence that Facebook received any benefits from this provision over and above those received by other bidders. In theory, an informational advantage for Facebook (if one existed) could give it a leg up over rival bidders. But any such advantage would arise only in auctions where Facebook participated, and Facebook has been bidding exclusively for in-app inventory since April 2020.[472]

249. In the mobile app advertising environment, matching is performed through mobile advertising IDs ("MAIDs") rather than cookies. As the UK Competition and Markets Authority has explained, these "strings of alphanumeric characters assigned to mobile devices … are a bedrock for personalized advertising on mobile, and are strong identifiers in widespread use in the adtech ecosystem, playing a similar role to cookies (although *there is no need to match them across apps because they are unique, device-wide identifiers*)."[473] Therefore, because MAIDs— which provide matching information for mobile app ads— are included in all Open Bidding requests[474] and because the NBA has applied nearly exclusively to transactions for in-app advertising, Google's commitment to ensure certain match rates had little practical effect (even if one were to assume, despite the absence of evidence, that Facebook received an advantage in this respect over other bidders).

request contains hosted match data earlier stored by Facebook for the given user via cookie matching integration"); [redacted]

[472] Since April 11, 2020, FAN focuses on mobile apps and does not operate in the web space any longer. See "Facebook will shut down Facebook Audience Network's mobile web arm," *Digiday*, February 5, 2020, available at https://digiday.com/media/facebook-plans-shut-facebook-audience-networks-mobile-web-arm/ (last accessed July 25, 2024) ("Facebook is planning to shut down the mobile web arm of its Audience Network starting on April 11 [2020]"); [redacted]

[473] "Appendix G: the role of tracking in digital advertising," *Online platforms and digital advertising market study*, United Kingdom Competition and Markets Authority, 2020, ("CMA Report"), available at https://assets.publishing.service.gov.uk/media/5fe49554e90e0711ffe07d05/Appendix_G_-_Tracking_and_PETS_v.16_non-confidential_WEB.pdf (last accessed July 25, 2024) at ¶¶ 32-33 (emphasis added).

[474] "Process the Request," *Google Authorized Buyers*, available at https://developers.google.com/authorized-buyers/rtb/request-guide (last accessed July 25, 2024).

250. *Spam Detection*. The Fourth Amended Complaint also contends that Google helped Facebook recognize "which impressions are likely targeted to spam (e.g., impressions targeted to bots, rather than humans). Facebook does not have to pay for such impressions. Other networks have asked Google for the same information, but Google has refused. So now Facebook has a further leg up over the competition in Google-run auctions: Facebook knows which impressions sold through Google are fake and worthless."[475] Contrary to this claim, it is my understanding that advertisers do not pay for impressions that Google identifies as spam.[476] As a result, this is also not an advantage uniquely provided to Facebook.

251. *Access to proprietary Google data*. Mr. Andrien alleges that Google "grant[ed] Facebook access to proprietary Google data," but does not indicate the nature of these data.[477] His only support for this allegation is a reference to a section of Professor Gans' expert report. Like Mr. Andrien, Professor Gans fails to explain what this "proprietary data" was.[478]

252. Moreover, Mr. Andrien offers no explanation of how the purported transfer of unspecified proprietary Google data to Facebook endowed the latter with advantages over other market participants. He thus provides no reason to believe that this purported information transfer violated Google's alleged "equal footing" commitments. Nor does he explain how this purported information transfer could have altered the behavior of other auction participants, or how it could have benefitted Google.

253. Finally, as noted earlier, Mr. Andrien contends that, "through the NBA, Google provided

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[475] FAC ¶ 431. The FAC leaves the impression that Google informs Facebook in real time which impressions are spam and which impressions are valid. This is contradicted by the language of the NBA, which provides that Google will "provide a mechanism that provides the other Party with (1) aggregate data that allows the other Party to validate billable impressions used to determine the amount to be paid to Publishers, with such reporting to be updated daily, and (2) the amount payable to Publishers." GOOG-TEX-00144513 at -530.

[476] See, e.g., Email from [redacted] (Google), "Re: Offline Spam Cost Transparency Launch," June 3, 2020, GOOG-DOJ-AT-01509210 at -211 ("As has been mentioned previously, we have now launched offline spam cost transparency metrics in Query Tool. These metrics provide insight into spam credits granted to bidders via our offline pipeline. Bidders can use these metrics to reimburse their customers for spend that we deemed invalid.").

[477] See Andrien Report at ¶ 53.

[478] Gans Report at ¶ 874 ("As part of the NBA, Meta [then Facebook] was also granted direct remittance, meaning Meta would pay publishers directly, *along with access to proprietary Google data*, a guaranteed match rate for Meta, and malware identification for Meta, which gave Meta advantages that were not available to other auction participants and resulted in an uneven playing field in subsequent auctions." (emphasis added)). [redacted] *Id*. at ¶ 874 and footnote 1116.

Facebook with advantages that were not available to other auction participants, and because of the confidentiality of the NBA, such advantages were not disclosed to other participants."[479] This claim does not suggest that the confidentiality of the NBA itself violated Google's alleged "equal footing" commitment. But even had Mr. Andrien alleged that the confidentiality of the NBA put bidders other than Facebook at a competitive disadvantage, he offers no explanation of why this might be the case or how this could have distorted auction outcomes.

254. The foregoing analysis shows that any differences in the terms enjoyed by Facebook over other bidders due to the NBA were immaterial, and so could not have given meaningful advantages to Facebook in the auctions in which it participated. The lack of any material differences means that other firms would not have altered their behavior had they known about the so-called "advantages," and there is no evidence that Google benefited financially from the alleged "equal footing" deception regarding the NBA. As a result, under Mr. Andrien's framework, the appropriate DTPA civil penalty for that alleged deception would be zero.[480]

F. Mr. Andrien's Proposed Civil Penalties Vastly Exceed Google's Incremental Profit from the Alleged Deception

255. Figure 5 summarizes Mr. Andrien's civil penalty estimates and my own. The first two bars show the lower and higher aggregate DTPA civil penalties proposed by Mr. Andrien, which are $7.2 billion and $21.8 billion, respectively. As described in Sections III, IV, and V, Mr. Andrien computes these penalties by multiplying his incorrect and inflated count of transactions by his arbitrary and inflated per-transaction penalties ranging from [redacted]

256. As discussed in Section VI, the third bar in Figure 5 shows that, after partially correcting for Mr. Andrien's errors in transaction count and per-transaction penalties, the aggregate DTPA civil penalty is $141.3 million. The fourth bar shows that excluding from Mr.

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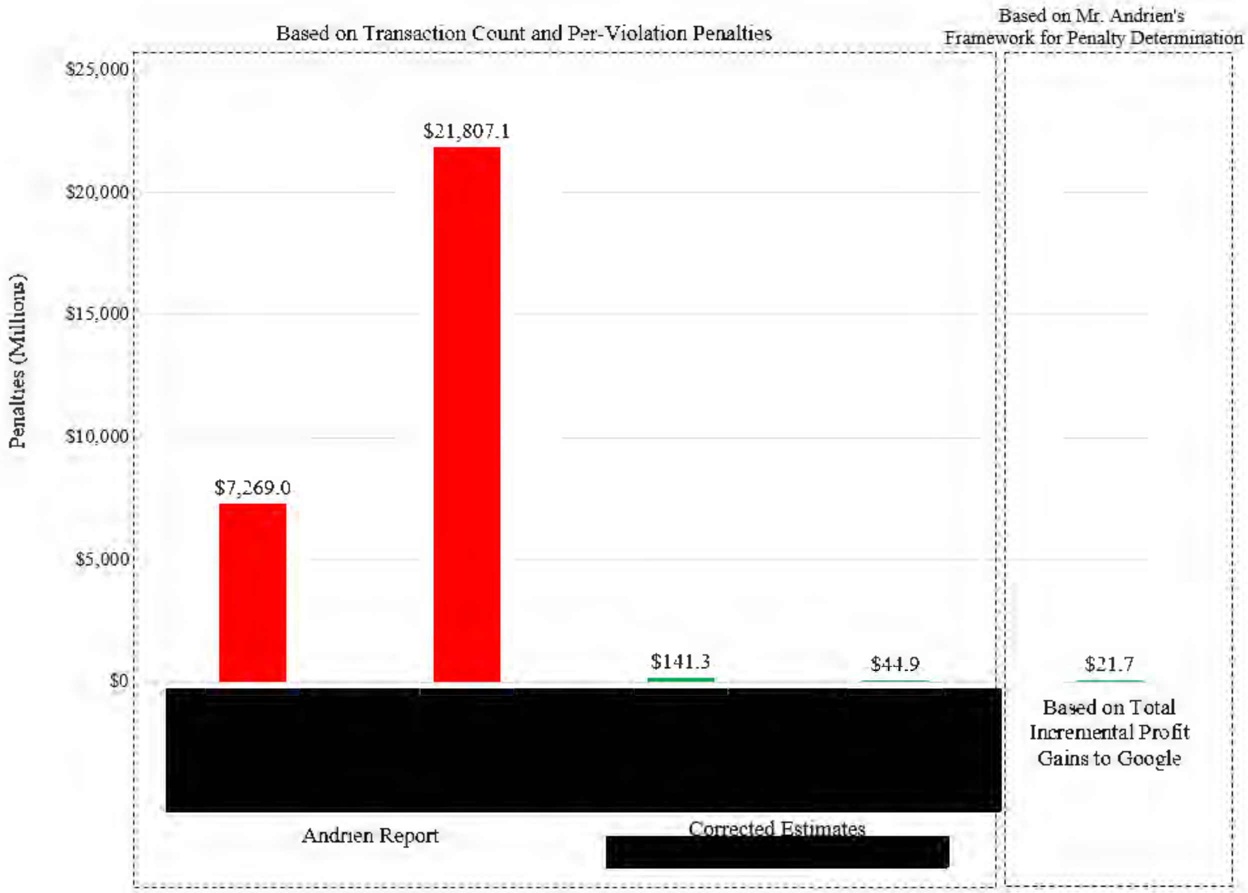
[479] Andrien Report at ¶ 53.

[480] [redacted]

Andrien's count those transactions that could not have been affected by the alleged deception would further reduce the aggregate DTPA civil penalty to $44.9 million.

257. As discussed in Section VII, Google likely did not benefit at all from any of the alleged deception, so under Mr. Andrien's framework, the aggregate DTPA civil penalty would be zero. As an alternative, assuming that advertisers in the but-for world would have responded as plaintiffs' experts theorize, I estimated the incremental profits that Google would have earned due to the alleged deception about RPO, DRS v1, DRS v2, and Bernanke to be $21.7 million,[481] which is represented by the fifth bar in Figure 5.

Figure 5
Mr. Andrien and Corrected Penalties



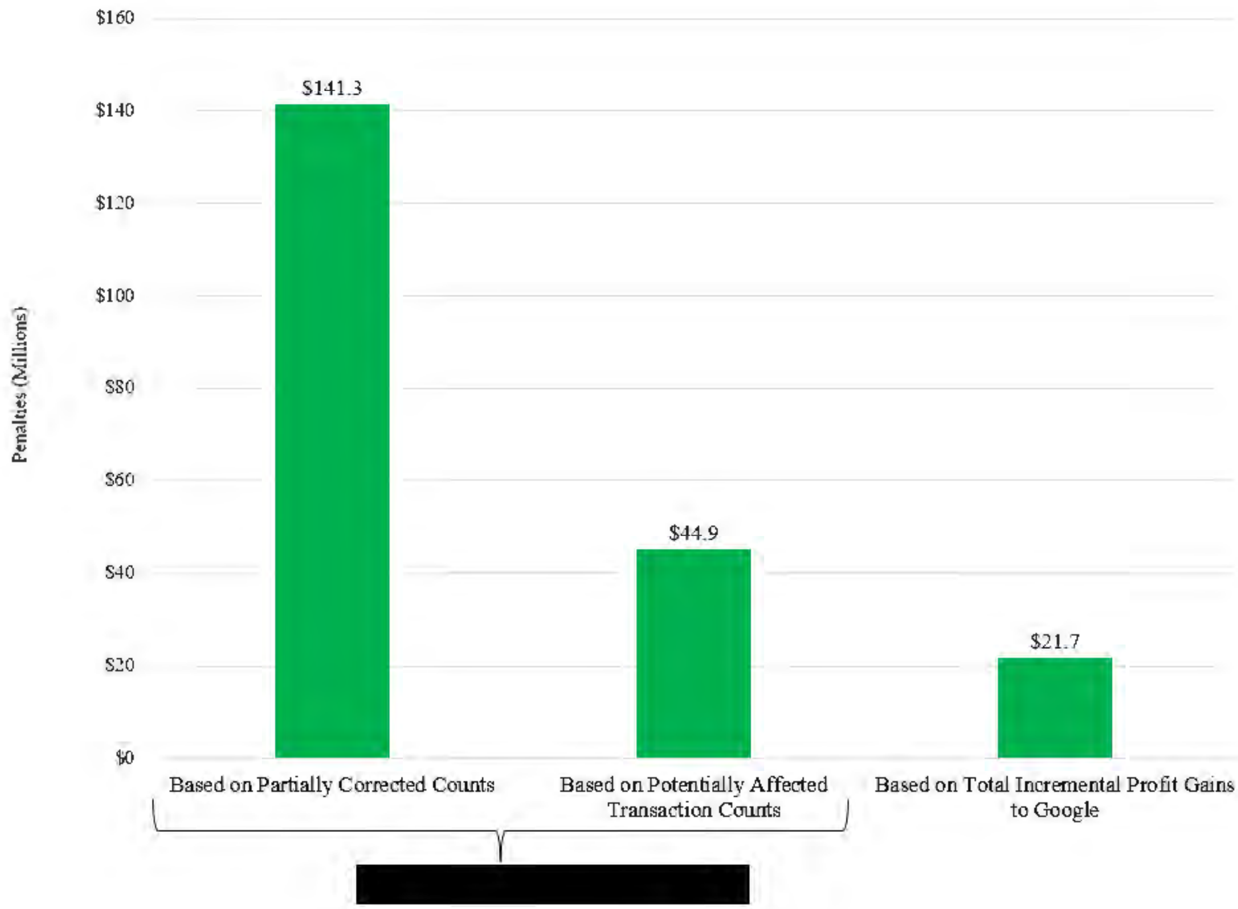
Notes & Sources: Andrien Report at Table 4; Table C3; Appendix D.

258. The extraordinarily inflated penalties proposed by Mr. Andrien make the final three bars in Figure 5 difficult to see, so I present the same information from those three bars in

[481] See Table D5.

Figure 6. That Figure underscores how significantly Mr. Andrien's calculations depart from his framework: while his framework would base DTPA civil penalties on the incremental benefits to Google from the alleged deception, the third bar shows that directly estimating those benefits implies far smaller penalties than Mr. Andrien's ad hoc calculations (shown in the first and second bars), even when those calculations are corrected for Mr. Andrien's numerous methodological errors.

Figure 6
Corrected Penalties



Notes & Sources: Table C3 and Appendix D.

VIII. Mr. Andrien's DTPA Analysis Suffers from Many Other Flaws

259. Mr. Andrien's framework for analyzing DTPA civil penalties focuses largely on the benefits that plaintiffs contend Google derived directly from the alleged deception. In addition to those direct benefits, Mr. Andrien postulates that Google benefited indirectly

from the alleged deception.

260. However, Mr. Andrien makes no effort to estimate the magnitude of these purported indirect benefits to Google, or even to demonstrate that they are significant. Nor does he provide any reason to believe that Google indirectly benefited from the alleged deception concerning the programs at issue, as distinguished from any indirect benefits Google may have received from the operation of the programs themselves.

261. Mr. Andrien also discusses measures of Google's financial performance and claims that Google has a "history of previous violations."[482] In offering his opinions on these topics, Mr. Andrien makes analytical mistakes and mischaracterizes the evidence on which he relies.

A. There Are No Indirect Benefits to Google That Would Justify Higher DTPA Civil Penalties

262. Mr. Andrien asserts that Google's allegedly deceptive practices could provide it with three indirect benefits.[483] As I describe below, none of these indirect effects is supported by facts or economic logic.

263. *First*, Mr. Andrien asserts that the alleged deception allowed Google to "obtain[] funds that can be used for additional employees, to improve their technology, or to improve its relative position in the industry, including by funding acquisitions."[484] Mr. Andrien provides no evidence that Google funded acquisitions using profits derived from the alleged deception discussed in his report. The only acquisitions he cites (the 2008 DoubleClick acquisition, and Google's purchases of Invite Media and Admeld in 2010 and 2011[485]) occurred long before the alleged deception. As he explains, the first version of Bernanke was launched in November 2013[486]; RPO was launched in March/April 2015[487]; the first version of DRS was launched in August 2015[488]; and the "equal footing"

[482] Andrien Report at ¶¶ 124-126.

[483] Andrien Report at ¶¶ 111-115.

[484] Andrien Report at ¶ 111.

[485] Andrien Report at ¶ 113.

[486] Andrien Report at ¶ 44.

[487] Andrien Report at ¶ 31.

[488] Andrien Report at ¶ 37. Mr. Andrien contends also that "[redacted] *Ibid.*

misrepresentation allegedly occurred in 2019.[489] Because the alleged deception began after the three cited acquisitions were consummated, it could not have generated funding for those acquisitions. Moreover, as a matter of economics, Google will hire additional employees and invest in additional technology, when the marginal benefits of doing so exceed the marginal costs.[490] Mr. Andrien offers no evidence that the alleged deception impacted Google's marginal benefits or costs of investing in employees and technology or impacted its ability to make such investments. And my own analysis in Section VII suggests that, even under plaintiffs' theory, the alleged deception generated sufficiently modest incremental profits that it likely did *not* enhance Google's ability to invest in employees and technology.

264. *Second*, Mr. Andrien posits that the "benefit to Google from RPO, DRS and Project Bernanke could include increased AdX win rates and revenue," generating "indirect network effects" that serve as barriers to entry against competitors.[491] By its own terms, this claim does not relate to the alleged *deception*; it relates only to Google's optimizations, which (by themselves) are not alleged to violate the plaintiff States' DTPAs.

265. Mr. Andrien's arguments with regard to indirect network effects also disregard how firms learn from market signals and respond to such learning. As I explain in Section II.B., advertisers and publishers rely on readily available return metrics and the advice of advertising agencies and other sophisticated intermediaries to determine which ad tech platforms to use. They also multi-home, which both facilitates comparisons of returns across platforms and reduces or even eliminates switching costs. This multi-homing enables advertisers and publishers to move business toward rivals' platforms when they offer higher returns than Google, which subjects Google to competitive pressure irrespective of past events. At any point in time, therefore, Google's success rests on

[489] Mr. Andrien states that Google has made its allegedly deceptive "equal footing" representation "since at least 2019." Andrien Report at ¶ 51.

[490] See, e.g., Mankiw, N. Gregory, *Principles of Microeconomics*, Cengage Learning, 5th ed. 2008, at 294 ("If marginal revenue is greater than marginal cost, the firm should increase its output. If marginal cost is greater than marginal revenue, the firm should decrease its output. At the profit-maximizing level of output, marginal revenue and marginal cost are exactly equal."). Marginal revenue and costs are the incremental revenue and costs associated with a specific decision a firm can make (e.g., hire additional employees).

[491] Andrien Report at ¶ 113.

continuing to provide high returns to advertisers and publishers, not on past market conditions as Mr. Andrien supposes.

266. *Third*, Mr. Andrien argues that the alleged deception "further[s]" Google's "monopoly position" and "reinforces" alleged antitrust violations,[492] concluding that the "deceptive misconduct alleged in this matter is properly viewed as part of an overall scheme by Google to dominate and maintain its place in the display advertising industry."[493] Such an argument is incorrect. As I discuss in Section II.B and Section VII, because of advertiser and publisher learning and experimentation the alleged deception was unlikely to impact auction outcomes. As a result, the alleged deception was also unlikely to have any ability to "further" any alleged "monopoly position" or "reinforce" any alleged antitrust misconduct. Furthermore, as I discuss in Section VII and Appendix D, even under plaintiffs' theories the impact of the alleged deception is limited, and thus unlikely to materially impact Google's ability "to dominate and maintain its place in the display advertising industry."

B. Measures of Google's Overall Financial Performance Are Not Relevant for Assessing Penalties Related to the Alleged Deception

267. Mr. Andrien asserts that Google's financial performance "is pertinent to [his] opinion as it establishes Google as [a] highly profitable and successful company during the relevant period and informs the amount necessary to deter Google's misconduct and its ability to pay a penalty related to this misconduct."[494] He also contends that Google's financial performance has been driven primarily by the success of its advertising business.[495]

268. Mr. Andrien's assertion that Google's overall financial performance is relevant to assessing civil penalties rests on two basic economic mistakes.

269. *First*, Mr. Andrien ignores the fundamental economic concept that profit maximizing

[492] Andrien Report at ¶ 114.

[493] Andrien Report at ¶ 115.

[494] Andrien Report at ¶ 77.

[495] See Andrien Report at ¶¶ 86-90 (describing how "Google's financial reports demonstrate that its success is driven primarily by advertising" as a general matter, i.e., where "advertising" is not limited to display advertising). While he purports to assess the performance of Google's "overall display advertising revenue and profit" by reference to profit and loss data for Google's "Display, Video, Apps, and Analytics" ("DVAA") product segment, Mr. Andrien does not assert that Google's display advertising business is a significant driver of the company's financial performance. See *id.* at ¶¶ 91-95.

firms make decisions on the margin.[496] That is, firms compare the incremental benefits and costs associated with the various possible decisions they can make. Marginal decision making means that the total profits of a firm, its revenue, its cash and short-term investments, or even its market capitalization are not driving factors in the decisions it makes. Instead, decisions are determined based on whether the marginal benefits exceed the marginal costs of undertaking an action.[497] As a result, Google's overall financial performance is largely irrelevant.

270. *Second*, most of Google's profits come from business activities (such as search advertising) other than display advertising, much less the alleged deception about the specific display-advertising practices at issue in this case. Under Mr. Andrien's framework, penalties should be designed to "eliminate Google's financial incentive to engage in the misconduct."[498] But while Mr. Andrien describes the trajectory of various measures of Google's financial performance, including its total assets,[499] total market capitalization and share price (i.e., its total market capitalization divided by the numbers of shares outstanding),[500] total revenue and total operating profit,[501] and total operating profit from advertising,[502] he fails to link these to the alleged deception at issue.[503] For example, Mr. Andrien cites Google's 2023 SEC Form 10-K and highlights that Google earned $307.394 billion in revenue in 2023,[504] but the 10-K reports that Google's total

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[496] See, e.g., Mankiw, N. Gregory, *Principles of Microeconomics*, Cengage Learning, 5th ed. 2008, at 294.

[497] Before taking costs into account, the marginal benefit to a firm of undertaking an action is its marginal revenue from that action. In order to maximize its profits, a profit-maximizing firm will choose the level of its activity at the level that causes this marginal benefit to equal its marginal cost from the activity. See, e.g., Mankiw, N. Gregory, Principles of Microeconomics, 5th ed. 2008, at 294 ("If marginal revenue is greater than marginal cost, the firm should increase its output. If marginal cost is greater than marginal revenue, the firm should decrease its output. At the profit-maximizing level of output, marginal revenue and marginal cost are exactly equal.").

[498] Andrien Report at ¶ 11(f) ("To deter Google from continuing its misconduct, the penalty must eliminate Google's financial incentive to engage in the misconduct.").

[499] Andrien Report at ¶ 81.

[500] Andrien Report at ¶¶ 82-85.

[501] Andrien Report at ¶¶ 78-79.

[502] Andrien Report at ¶¶ 87-90.

[503] Mr. Andrien explicitly indicates that he was unable to quantify the benefits to Google of the alleged deception, which implies that he was unable to ascertain whether or to what extent such deception affected Google's financial performance. See Andrien Report at ¶¶ 116-118.

[504] See Andrien Report at ¶ 78 and footnote 214.

advertising revenue was $237.855 billion in 2023,[505] of which $175.033 billion came from its "Google Search and other properties" line of business.[506] By contrast, $31.312 billion in revenue[507]—representing 10.2 percent of Google's total revenue[508]—came from Google Network, the line of business that includes the products at issue in this case (as well as other products).[509]

C. Google Does Not Have a History of Violating DTPAs

271. Mr. Andrien argues that Google's past history of paying fines and entering into settlements should be taken into account when setting penalties for Google's alleged DTPA violations in this case.[510]

272. In support of that argument, Mr. Andrien relies primarily on what he claims to be a complaint prepared by the Federal Trade Commission, asserting that "[i]n its May 2023 complaint, the FTC counts Google fines and settlements of over $12 billion from 2011 to 2023."[511] Mr. Andrien misinterprets this document, which appears to be a piece of advocacy prepared by Oracle Corporation, one of Google's many competitors,[512] and submitted to the FTC to encourage regulatory action against Google.[513] Contrary to Mr.

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[505] Alphabet Inc. Form 10-K for the fiscal year ended December 31, 2023, *Alphabet Investor Relations*, 2024, at 35, available at https://abc.xyz/assets/43/44/675b83d7455885c4615d848d52a4/goog-10-k-2023.pdf (last accessed July 26, 2024).

[506] *Id.* at 35.

[507] *Ibid.*

[508] Calculated as $31.312 billion / $307.394 billion.

[509] Alphabet Inc. Form 10-K for the fiscal year ended December 31, 2023, *Alphabet Investor Relations*, 2024, at 31, available at https://abc.xyz/assets/43/44/675b83d7455885c4615d848d52a4/goog-10-k-2023.pdf (last accessed July 26, 2024) ("Google Network … includes revenues generated on Google Network properties participating in AdMob, AdSense, and Google Ad Manager.").

[510] Andrien Report at ¶¶ 124-126.

[511] Andrien Report at ¶ 125.

[512] See "Why Oracle Cloud Infrastructure over Google Cloud Platform," *Oracle*, available at https://www.oracle.com/cloud/oci-vs-google-cloud/ (last accessed July 25, 2024).

[513] This purported "FTC complaint" is replete with evidence that it is in fact not an FTC complaint but is an advocacy document submitted by Oracle. For example, its cover page reads, "Submitted by: Kenneth Glueck, Executive Vice President, Oracle America, Inc., 901 F Street NW, Suite 800, Washington, DC 20004," while its Introduction and Summary argues that "the Federal Trade Commission ('Commission') *should* initiate an investigation [of] . . . Google." See Oracle Corporation, "Draft Complaint In the Matter of Alphabet, Inc.," May 8, 2023, at cover page and 1. The public record affirms that Oracle has been active in encouraging enforcers to bring actions against Google. See Nix, Naomi, "Oracle's Hidden Hand is Behind the Google Antitrust Lawsuits," *Los Angeles Times*, December 24, 2020, available at https://www.latimes.com/business/story/2020-12-24/oracle-google-antitrust-lawsuits (last accessed July 25, 2024).

Andrien's claim, it is not a document filed by the FTC against Google.

273. My own analysis of the $17 billion in settlements and fines listed in the Oracle document, as well as two other matters cited by Mr. Andrien,[514] is summarized in Table 6. That analysis reveals that, contrary to Mr. Andrien's claims, Google does not have a history of engaging in conduct similar to the deception alleged in this case.

Table 6
Summary of Settlement Payments and Fines Relied Upon by Mr. Andrien

	Worldwide			U.S. Only		
	Total	Settlements	Fines + Sanctions	Total	Settlements	Fines + Sanctions
Total Settlement and Fines paid	$16,965,789,361	$6,667,592,670	$10,298,196,691	$6,392,466,374	$6,391,390,659	$1,075,715
Claims similar to the deceptive conduct alleged in this case	$0	$0	$0	$0	$0	$0
Other claims (e.g., privacy, antitrust)	$16,965,789,361	6,667,592,670.0	$10,298,196,691	$6,392,466,374	$6,391,390,659	$1,075,715

Notes: [1] Calculations include cases cited in the Oracle draft complaint and cases which are not listed in the Oracle draft complaint but are referred to by Mr. Andrien. See Andrien Report at ¶ 125 and footnotes 310-312. [2] U.S. totals are driven largely by one case where plaintiffs estimated the "value" of agreed injunctive relief was $5 billion, while Google disputed plaintiffs' "legal and factual characterizations." See Plaintiffs' Unopposed Motion for Final Approval of Class Action Settlement at 3 and footnote 2, *Brown et al. v. Google LLC*, No. 4:20-cv-03664 (N.D. Cal. April 1, 2024), ECF No. 1096.
Sources: See Table G1 in Appendix G.

274. *First*, most of the $17 billion in settlements and fines was incurred in connection with matters arising outside of the United States. This is reflected in the first row of Table 6, which indicates that nearly two-thirds of the total amount was to parties outside the U.S.[515] Mr. Andrien has made no effort to show that the legal authorities under which those settlements or fines were paid are similar to the plaintiff States' DTPAs. Nor has he shown any similarity between the conduct to which those settlements or fines relate and the alleged deception on which plaintiff States' DTPA claims are based.

275. *Second*, nearly all of the $6.4 billion related to U.S. matters were settlements, rather than fines or other sanctions. The first row of Table 6 shows that only $1.1 million, or 0.017%

[514] See Andrien Report at ¶ 125.

[515] ($16,966,289,361 - $6,392,966,374)/ $16,966,289,361 = 62.3%.

of the $6.4 billion, was paid to a U.S. party as a fine or other sanction.[516] This fact is important because I understand that none of the U.S. privacy settlements cited by Mr. Andrien involved determinations or admissions of liability.[517] Thus, there is no basis for asserting that any of these settlements were consequences of illegal conduct by Google. These settlements could just as easily be explained as efforts to avoid the costs and uncertainties of litigation and the associated distractions of executives who are more usefully employed in running Google's business. Such settlement amounts do not indicate that Google has engaged in any misconduct, much less a similar type of misconduct to what is at issue in this case.

276. *Third,* none of the $17 billion in worldwide settlements and fines related to conduct similar to the deception alleged in this matter. This fact is shown in the second and third rows of Table 6. In fact, as shown in the third column of Table G1 in Appendix G, most of the settlements are related to alleged consumer privacy or antitrust violations, neither of which is conduct for which Mr. Andrien has proposed civil penalties.[518]

277. *Fourth,* Mr. Andrien's assertion that settlements and fines—including for unrelated behavior—are relevant in assessing civil penalties is inconsistent with his own framework for assessing penalties. As noted earlier, Mr. Andrien's framework for determining the appropriate penalty is to "eliminate Google's financial incentive to engage in the misconduct."[519] This framework is fundamentally inconsistent with using past settlements for unrelated conduct to justify inflating penalties.

278. *Finally*, Mr. Andrien claims that incurring more than $12 billion in fines and settlements

[516] Of this $6.4 billion in U.S. settlements, $5 billion is attributable to the "value" that plaintiffs in one case attributed to injunctive relief (i.e., not a cash penalty). See Plaintiffs' Unopposed Motion for Final Approval of Class Action Settlement at 3, *Brown et al. v. Google LLC*, No. 4:20-cv-03664 (N.D. Cal. April 1, 2024), ECF No. 1096. Although Google did not oppose settlement, it disputed "the legal and factual characterizations" contained in plaintiffs' motion. See *id.* at 3, footnote 2.

[517] These settlements are listed in Table G1 Sources [32]-[34], [36], [38], [40]-[44], and [47-48].

[518] I understand that the only payment for a claim bearing any similarity to the ones in this case was a $155 million settlement related to the improper use of location data for advertising and was brought under California's Unfair Competition Law and False Advertising. See Stempel, Jonathan, "Google to pay $155 Million in Settlements Over Location Tracking," *Reuters*, September 15, 2013, available at https://www.reuters.com/legal/google-pay-155-million-settlements-over-location-tracking-2023-09-15/ (last accessed July 25, 2024). However, even this amount has no logical connection to Mr. Andrien's analysis because Mr. Andrien did not base his proposed DTPA civil penalties on alleged violations of consumer privacy.

[519] Andrien Report at ¶ 11(f).

was not "detrimental to Google."[520] That is wrong as a matter of economics. Standard economic analysis recognizes that firms seek to maximize their profits.[521] Because every settlement and fine reduced Google's profits, each was, by definition "detrimental."

Respectfully submitted,

Steven N. Wiggins, Ph.D.

July 30, 2024
Date

[520] Andrien Report at ¶ 126.

[521] See, e.g., Henderson, James M. and Richard E. Quandt, *Microeconomic Theory: A Mathematical Approach*, McGraw-Hill Book Company, Inc., 3rd ed. 1980, at 78-79.

Appendix A: Curriculum Vitae

STEVEN N. WIGGINS

ADDRESS:

[redacted] [redacted]

EDUCATION:

Massachusetts Institute of Technology, Ph.D., 1979
Oklahoma State University, B.A., 1975

PROFESSIONAL EXPERIENCE:

Senior Consultant, Charles River Associates, 2000 - present
Senior Consultant, LECG, 1996 – 2000
Professor Emeritus of Economics, Texas A&M University, 2022 - present
Professor of Economics, Texas A&M University, 1991 - 2021
Associate Professor of Economics, Texas A&M University, 1984 - 1991
Assistant Professor of Economics, Texas A&M University, 1979 - 1984

HONORS AND AWARDS:

Distinguished Achievement Award for Teaching, College Level, Association of Former Students, Texas A&M University, 2017.
Dr. Dennis Berthold Innovations in Teaching Endowment Award, College of Liberal Arts, Texas A&M University, 2017.
Jeff Edwardson Outstanding Undergraduate Teaching Award, Department of Economics, Texas A&M, 2016.
Thunderbird Award, Business Association of Latin American Studies, Barcelona, Spain, 2010.
George and Mary Jordan Professor of Economics and Public Policy, Texas A&M University, 1993 - 1998.
Rex B. Grey Professor, Private Enterprise Research Center, Texas A&M University, 1986 - 1989.
Visiting Distinguished Lecturer on American Economic Institutions, Johann Wolfgang Goethe University, Frankfurt am Main, May - July 1988.
University Teacher/Scholar, Texas A&M Honors Program, 1986-87.
Visiting Distinguished Lecturer on Economic Institutions Professor, University of the Saarlands, Saarbrucken, West Germany, May - August 1984.

DISSERTATION TITLE:

Product Quality Regulation and Innovation in the Pharmaceutical Industry

RESEARCH INTERESTS:

Industrial Organization, Regulation, and Antitrust

LAST TEN YEARS OF DEPOSITION AND TRIAL TESTIMONY:

2024 Converge Midstream, L.L.C. v. Magellan Crude Oil Pipeline Company, L.P. and Magellan Midstream Partners, L.P. Cause No. 2022-26294, District Court, Harris County, Texas, 113th Judicial District
Deposition

2023 IN RE: Little River Healthcare Holdings, LLC, et al., Case No. 18-60526-rbk, United States Bankruptcy Court, Western District of Texas, Waco Division
Deposition

2022 IN RE: Broiler Chicken Antitrust Litigation, MDL Docket No. 1:16-CV-08637, United States District Court, Northern District of Illinois, Eastern Division
Deposition

2019 IN RE: EpiPen (Epinephrine Injection, USP) Marketing, Sales Practices and Antitrust Litigation, MDL No. 2785, Case No. 17-md-2785-DDC-TJJ, United States District Court for the District of Kansas
Deposition

2018 Academy of Allergy & Asthma in Primary Care and United Biologics, LLC D/B/A United Allergy Services. v. American Academy of Allergy, Asthma & Immunology; American College of Allergy, Asthma & Immunology; Dallas Allergy and Asthma Center, P.A.; Joint Council of Allergy, Asthma & Immunology; Lyndon E. Mansfield M.D., P.A, A Professional Association; PSF, PLLC; Donald Aaronson, MD; Gary Gross, MD; Lyndon Mansfield, MD; James Sublett, MD; David Weldon, MD; Allergy and Asthma Network/Mothers of Asthmatics, Inc.; Tonya Winders, James Wallen & Phadia US Inc.; Atlanta Allergy & Asthma Clinic, P.A.; Stanley Fineman, MD, Civil Action No. 14-35, United States District Court for the Western District of Texas, San Antonio Division
Trial Testimony

2017 Academy of Allergy & Asthma in Primary Care and United Biologics, LLC D/B/A United Allergy Services. v. American Academy of Allergy, Asthma & Immunology; American College of Allergy, Asthma & Immunology; Dallas Allergy and Asthma Center, P.A.; Joint Council of Allergy, Asthma & Immunology; Lyndon E. Mansfield M.D., P.A, A Professional Association; PSF, PLLC; Donald Aaronson, MD; Gary Gross, MD; Lyndon Mansfield, MD; James Sublett, MD; David Weldon, MD; Allergy and Asthma Network/Mothers of Asthmatics, Inc.; Tonya Winders, James Wallen & Phadia US Inc.; Atlanta Allergy & Asthma Clinic, P.A.; Stanley Fineman, MD, Civil Action No. 14-35, United States District Court for the Western District of Texas, San Antonio Division
Deposition

2013/2014 MM Steel, LP vs. Reliance Steel & Aluminum Co., Chapel Steel Corp., American Alloy Steel, Inc., Arthur J. Moore, JSW Steel (USA) Inc., Nucor Corp. & SSAB Enterprises, LLC D/B/A SSAB Americas, Case No. 4:12-cv-01227, United States District Court for the Southern District of Texas, Houston Division
Deposition and Trial Testimony

OTHER SELECTED CONSULTING EXPERIENCE:

IN RE: EpiPen (Epinephrine Injection, USP) Marketing, Sales Practices and Antitrust Litigation, MDL No. 2785, Case No. 17-md-2785-DDC-TJJ, United States District Court for the District of Kansas

Academy of Allergy & Asthma in Primary Care and United Biologics, LLC D/B/A United Allergy Services. v. American Academy of Allergy, Asthma & Immunology; American College of Allergy, Asthma & Immunology; Dallas Allergy and Asthma Center, P.A.; Joint Council of Allergy, Asthma & Immunology; Lyndon E. Mansfield M.D., P.A, A Professional Association; PSF, PLLC; Donald Aaronson, MD; Gary Gross, MD; Lyndon Mansfield, MD; James Sublett, MD; David Weldon, MD; Allergy and Asthma Network/Mothers of Asthmatics, Inc.; Tonya Winders, James Wallen & Phadia US Inc.; Atlanta Allergy & Asthma Clinic, P.A.; Stanley Fineman, MD, Civil Action No. 14-35, United States District Court for the Western District of Texas, San Antonio Division

Prometheus Franchise Restaurant Holdings, LLC, Southeast QSR, LLC, Coastal QSR, LLC, South Beach QSR, LLC, Florida Bells, LLC, and Mid-South Bells, LLC

Valero Energy Corporation and Subsidiaries

MM Steel, LP vs. Reliance Steel & Aluminum Co., Chapel Steel Corp., American Alloy Steel, Inc., Arthur J. Moore, JSW Steel (USA) Inc., Nucor Corp. & SSAB Enterprises, LLC D/B/A SSAB Americas, Case No. 4:12-cv-01227, United States District Court for the Southern District of Texas, Houston Division

Mary Plubell and Ted Ivey, on behalf of themselves and all others similarly situated vs. Merck, & Co., Inc., Case No. 04CV235817, In the Circuit Court of Jackson County, Missouri at Independence

City of Clinton, Arkansas, vs. Pilgrim's Pride Corporation, and Shelia Adams and James Adams, et al., vs. Pilgrim's Pride Corporation, Action No. 4:09-CV-386-Y (Consolidated With 4:09-CV-387-Y)

April Krueger, Individually and on Behalf of All Others Similarly Situated vs. Wyeth, Inc. F/K/A American Home Products, A Pennsylvania Corporation; Wyeth Pharmaceuticals F/K/A Wyeth Ayerst Pharmaceuticals, A Pennsylvania Corporation; And Does 1 Through 100, Inclusive, Case No 03:03-CV-02496-JAH-AJB, United States District Court Southern District Of California

Shelia Adams and James Adams, et al. v. Pilgrim's Pride Corporation, Civil No. 2:09-CV-397 (TJW-CE), in the United States District Court for the Eastern District of Texas, Marshall Division

Jean Smith and Loria Ivie, on behalf of themselves and others similarly situated v. Barry Collinsworth, Thomas Pugh, United American Insurance Company, Heartland Alliance of America Association, Farm & Ranch Healthcare, Inc. and John Does 1-20, Civil Action No. CV2004-72-2, In the Circuit Court of Saline County, Arkansas

People's Electric Cooperative v. Western Farmers Electric Cooperative, CIV-09-1129-HE, In the United States District Court for the Western District of Oklahoma

Canadian Valley Electric Cooperative, Inc. v. Western Farmers Electric Cooperative, In the District Court of the 22nd Judicial District Sitting in and for Seminole County, Seminole Division, State of Oklahoma

State of Louisiana, ex rel. James D. Caldwell, Jr., Attorney General v. Merck & Co., Inc., MDL No. 1657, United States District Court, Eastern District of Louisiana

Michael H. Kirsch, D.D.S., individually and on behalf of all others similarly situated vs. Horizon Blue Cross Blue Shield of New Jersey, Inc., Superior Court of New Jersey Law Division – Essex County

Alcoa Inc., vs. Luminant Generation Company LLC, Luminant Mining Company LLC, Sandow Power Company LLC, Luminant Energy Company LLC, and Energy Future Holdings Corp., In the District Court of Milam County, Texas, 20th Judicial District, No. 32,540

In Re: Pilgrim's Pride Corporation, et al., Case No. 08-45664 (DML), In the United States Bankruptcy Court for the Northern District of Texas, Fort Worth Division

Frank's Casing Crew and Rental Tools, Inc. and Frank's International, Inc. v. Tesco Corporation and Tesco Corporation (US), Civil Action No. 2:07-cv-15, In the United States District Court for the Eastern District of Texas, Marshall Division

Logan Farms v. Smithfield, et al; Case No. 05-0766. In the United States District Court for the Southern District of Texas, Houston Division

Alfred T. Giuliano, Trustee on Behalf of Debtors' Estate of Graham-Field Health Products v. Ernst & Young LLP; AAA Case No. 18 199 10398 02 - American Arbitration Association Professional Accounting and Related Services Arbitration Tribunal

The State of Texas v. Merck & Co., Inc., Cause No. GV 503021, In the District Court, Travis County, Texas, 345th Judicial District

Board of Regents, The University of Texas System, on behalf of The University of Texas at Austin and Hydro-Québec v. Nippon Telephone and Telegraph Corporation, Cause No. A 01 CA 47, In the Western District of Texas, Austin Division

ReedHycalog UK, Ltd., ReedHycalog, LP, and Grant PrideCo, Inc. vs. Baker Hughes Oilfield Operations, Halliburton Energy Services, Inc., US Synthetic Corporation, In the U.S. District Court for the Eastern District of Texas, Tyler Division; Civil Action No. 6:06-CV-222(LED)

Champagne Metals, an Oklahoma Limited Liability Company vs. Ken-Mac, Inc., an Ohio corporation; Samuel, Son & Co., Limited, an Ontario, Canada corporation, Samuel Specialty Metals, Inc., a New Jersey corporation, Metal West, L.L.C., an Alabama limited liability company, Integris Metals, Inc., a New York corporation, Earle M. Jorgensen Company, a Delaware corporation, and Ryerson Tull, Inc., an Illinois corporation; in the U.S. Dist. Court for the Western District of Oklahoma; No. CIV-02-528-C.

Rick Love, M.D., et al., vs. Blue Cross and Blue Shield of Arizona, Inc., et al., in the U.S. District Court, Southern District of Florida, Miami Division; Case No. 03-21296-CIV-Moreno.

Century Martial Art Supply, Inc. v. Martial Arts Enterprises, Inc.; No. 03-1711-T; USDC WD Oklahoma; Arbitration Number 71 181 J 00407 05

Brazos River Authority v. Ionics, Incorporated; Civil Action No. W 03 CA 324, in the U.S. District Court of Texas, Waco Division

Parkade Center, Inc. v. Simon Property Group (Texas), L.P. and Simon Property Group (Delaware), Inc.; Cause No. C-2584-06-1, in the 398th Judicial District of Hidalgo County, Texas

Natalie M. Grider, M.D., et al. v. Keystone Health Plan Central, Inc., et al.; In the U.S. District Court for the Eastern District of Pennsylvania

Milissa Boisseau v. 7-Eleven, Inc.; Cause No. 04-05250; In the 68th Judicial District Court, Dallas County, Texas

John Ivan Sutter, M.D., P.A. on behalf of himself and all others similarly situated vs. Horizon Blue Cross Blue Shield of New Jersey, Inc., Superior Court of New Jersey, Law Division Essex County, Docket No. ESX-L-3685-02

EEMSO, Inc. v. Compex Technologies, Inc. f/k/a Rehabilicare, Inc. and Iomed, Inc.; Civil Action No. 3:CV-05-0897-P; In the United States District Court, Northern District of Texas, Dallas Division

Scruggs Management Services, Inc. d/b/a Scruggs Consulting v. Panasonic Communications & Systems Co., et al.; No. 01-0151; In the Supreme Court of Texas

Gary Shapiro and Rich Fitzgerald, individually and on behalf of all others similarly situated v. International Business Machines Corporation, Docket No. MID-L-007413-02; Superior Court of New Jersey Law Division: Middlesex County

Crest Foods of Edmund, LLC v. Wal-Mart Stores, Inc., Cause No. CIV-00-1659-F; In the U.S. District Court, Western District of Oklahoma

Andrew Daugherity, et al., v. International Business Machines Corporation, Cause No. 23,162; In the District Court of Burleson County, Texas, 21st/335th Judicial District

Logan Farms, Inc. and James P. Logan, Jr. v. Honeybaked Ham, L.P., Mi., et al., Cause No. H-01-1611; In the U.S. District Court for the Southern District of Texas, Houston Division

Park Cities Hotel, L.P. v. Meristar Management Company, L.L.C. Cause No. 01-08447; In the District Court, Dallas County, Texas, B-44th Judicial District

Marion Crane, et al., v. International Paper Company and Canal Wood, LLC; Civil Action No.: 3-02-3352-17; In the United States District Court for the District of South Carolina, Columbia Division

Richard A. Lippe, et al. v. Bairnco Coporation, et al. Case No. 96-CV-7600, United States District Court For the Southern District of New York

Alcatel USA, Inc. v. Cisco Systems, Inc. Case No. 4:00cv199, United States District Court for the Eastern District of Texas Sherman Division

IMODCO Inc. v. FMC Corporation and SOFEC, Inc., Cause No. H-99-2174, United States District Court, Southern District of Texas, Houston Division

American Permanent Ware Company v. Emerson Electric Co., d/b/a Chromolax, Don Shuhart Company, and Maytag Corp. d/b/a Heatube, Maytag Clarence Component Parts, Cause No. 00-07351; In the 298th Judicial District, Dallas County, Texas

Palacio del Rio, Ltd. v. Hilton Hotels Corporation, et al., Cause No. 2000-CI-13691; In the 407th Judicial District Court, Bexar County, Texas

Gilbert Moreno Enterprises, Inc. d/b/a La Monita, et al., v. Gruma Corporation, Individually and d/b/a Mission Foods Corporation, et al., Cause No. G-0-546; In the U.S. District Court for the Southern District of Texas, Galveston District

United States of America v. Moore Supply Co. et al., CR-H-94-17, United States District Court, Southern District of Texas, Houston Division

Brand Name Prescription Drug Antitrust Litigation, 94 C 897, MDL 997, United States District Court, Northern District

Manuel Arechiga, Sr. v. Chevron U.S.A., Inc. and G.E. Darby, No. C-93-00844-D1, District Court of Webb County, Texas 49th Judicial District

Acme Plumbing & Heating Co., Inc. and Bruce Brooks v. Morrison Supply Company, Inc., et al., No. 80534-B, District Court of Potter County, Texas 181st District Court

Todd E. Samuelson, M.D. and Todd E. Samuelson, M.D., P.A., Individually and On Behalf of All Other Persons Similarly Situated, Appellants V. United Healthcare of Texas, Inc. and United Healthcare Insurance Company, Appellees, No. 2-01-407-CV, Court of Appeals of Texas, Second District, Fort Worth

Humco Holding Group, Inc. v. The Dow Chemical Company; CV No.: 5:04-CV-287 (TJW); United States District Court for the Eastern District of Texas, Texarkana Division

Schlotzsky's, Ltd. v. Sterling Purchasing & National Distribution Co. and Commissary Operations, Inc. and The Sygma Network, Inc.; Civil Action No. A05CA195 SS, United States District Court for the Western District of Texas, Austin Division

Star Fuel Marts, LLC v. Murphy Oil USA, Inc., et al.; No. CIV-02-0202-F; United States District Court, Western District, Oklahoma

Bolick Distributors Corporation v. Armstrong Holdings, Inc., Armstrong Wood Products, Inc., Robbins Hardwood Floorings, Inc., Hartco Flooring Company; Civil Action No.: 3-03-CV-1386-N; In the U.S. District Court for the Northern District of Texas, Dallas Division

Port of Houston Authority v. GB Biosciences Corporation, GB Biosciences Holdings, Inc., ISK Magnetics, Inc., Occidental Chemical Corporation, John Stansbury, William Hutton, Zeneca Holdings, Inc., Zeneca Inc., Zeneca AG Products, Inc., Syngenta AG, Syngenta Corporation, Syngenta Crop Protection, Inc.; Cause No. 2001-07795, In the District Court of Harris County, Texas, 151st Judicial District

Biovail Pharmaceuticals, Inc. v. Eli Lilly Company; United States District Court, for the Eastern District of North Carolina, Western Division, Case No. 5 :01CV352-BO(3)

Ruhrpumpen, Inc. v. Flowserve Corporation et al, Civil Action No. 3:02-CV-01931, USDC, North District of Texas, Dallas Division

Esther Kiobel et al v. Royal Dutch Petroleum Company; Shell Transport and Trading Company, p.l.c.; Civil Action No. 02 CV 7618 (KMW), USDC Southern District of New York

BSA Enterprises, Inc. d/b/a BSA Provider Network v. Healthsmart Preferred Care II, L.P.; No. 91253-E - In the 108th District Court, Potter County, Texas

HomeTeam Pest Defense LLC v. Curtis Warren and OnDuty Security Systems, Inc.; Cause No. C-2004-32777; In the District Court, Harris County, Texas; 189th Judicial District

KCI Licensing, Inc., KCI USA, Inc., and Wake Forest University Health Sciences v. Bluesky Medical Corporation, Medela AG, Medela, Inc., and Patient Care Systems, Inc., In the United States District Court for the Western District of Texas, San Antonio Division; Civil Action No. SA-03-CA-0832-RF; Kinetic Concepts, Inc.

VAE Nortrak North America, Inc., Meridian Track Products Corp., and Meridian Rail Information Systems Corp. v. Progress Rail Services Corporation; Civil Action No. 03 CV 1480; In the United States District Court for the Northern District of Alabama, Middle Division

Brazos River Authority v. Ionics, Incorporated; Civil Action No. W 03 CA 324, in the U.S. District Court of Texas, Waco Division

In the Matter of the Arbitration Ordinance (Chapter 341 of the Laws of Hong Kong) and In the Matter of An Arbitration Between Brunswick Bowling & Billiard Corporation and Shanghai Zhonglu Industrial Company Limited and Chen Rong

PUBLICATIONS:

"Nonlinear Pricing Strategies and Competitive Conditions in the Airline Industry," with Manuel A. Hernandez, *Economic Inquiry*, Vol. 52, No. 2, April 2014, 539–561.

"Airline Pricing, Price Dispersion, and Ticket Characteristics On and Off the Internet," with Anirban Sengupta, *American Economic Journal: Economic Policy*, 2014, vol. 6, issue 1, pages 272-307.

"The Impacts of Breakthrough Drug Classes on Total Healthcare Expenditures," with Zeynal Karaca, *Journal of Health Economics and Outcomes Research*, 2013;1(3):276-95.

"The Evolving Modern Theory of the Firm," with Rob Maness, in *Handbook of Managerial Economics*, Oxford University Press, July 2013.

"Comparing Price Dispersion On and Off the Internet Using Airline Transaction Data," with Anirban Sengupta, *Review of Network Economics*, Vol. 11, Issue 1, March 2012, pages 1-38.

"Examining the effect of low cost carriers on nonlinear pricing strategies of legacy airlines", with Manuel A. Hernandez and Anirban Sengupta, in *Pricing Behavior and Non-Price Characteristics in the Airlines Industry*, James Peoples, Editor, 2011.

"Identifying Market Power through Accounting Profits and Margins," *Market Power in Antitrust Law*, Philip Nelson, editor, American Bar Association, 2004.

"Price Competition in Pharmaceuticals: The Case of Anti-infectives," with Robert Maness, *Economic Inquiry*, vol. 42, no. 2, April 2004, 247-263.

"Demand Systems and the 'True' Subindex of the Cost-of-Living for Pharmaceuticals," with Michael R. Baye and Robert Maness, *Applied Economics*, 1997, 29, 1179-1189.

"Competition or Compensation: Supplier Incentives under the American and Japanese Subcontracting System," with Curtis Taylor, *American Economic Review*, September, 1997.

"Intangible Capital, Hedonic Pricing and International Transfer Pricing," with David Raboy, *Public Finance Review*, Vol. 25, No. 4, July, 1997, pp. 347-365.

"Price Premia to Name-Brands: An Empirical Analysis," with David Raboy, *Journal of Industrial Economics*, Vol. XLIV, NO. 4, December 1996, pp. 377-388.

"Entrepreneurial Enterprises, Endogenous Ownership, and the Limits to Firm Size," *Economic Inquiry*, Vol. XXXIII, No. 1, January 1995, pp. 54-69.

"Institutional Control and Large-Scale, Long-Term Hazards," with Al H. Ringleb, *Government and Risk Bearing*, Mark Sniderman, ed., Federal Reserve Bank, Cleveland, 1993.

"Adverse Selection, Liability, and Long Term Hazards," with Al Ringleb, *Journal of Legal Studies*, Vol. XXI, No. 1, January 1992, pp. 189-215.

"Takeover Raids: Managerial Incompetence or Managerial Shirking," with James Griffin, *Economic Inquiry*, Vol. XXX, No. 2, April 1992, pp. 355-370.

"The Economics of Contracts and Firms: A Selective Survey," *Journal of Institutional and Theoretical Economics*, Vol. 147, No. 4, December 1991, pp. 603-661.

"The Comparative Advantage of Long Term Contracts and Firms," *Journal of Law, Economics, and Organization*, Vol. 6(1), Spring 1990, pp. 155-170. Reprint in *The Theory of the Firm*, Mark Casson, Editor, Edward Elgar Publishing Limited, Cheltenham, United Kingdom, Winter of 1997.

"Liability and Large-Scale, Long Term Hazards," with Al Ringleb, *Journal of Political Economy*, 1990, Vol. 98(3), pp. 574-595. Reprint in *Economics and Liability for Environmental Problems*, Kathleen Segerson, Editor, Burlington, VT: Ashgate, 2002.

"Social Control and Labor Relations in the American South Before 1950: Comment," *Journal of Institutional and Theoretical Economics*, 1988, Vol. 145(1), pp. 158-161.

"Firm Heterogeneities and Cartelization Efforts in Domestic Crude Oil," with G. Libecap, *Journal of Law, Economics and Organization*, Vol. 3(1), Spring 1987, pp. 1-25.

“Organizational Theory, Information Processing, and Short Run Dynamics: Theory and Empirical Tests,” *Journal of Institutional and Theoretical Economics*, Vol. 143(1), March 1987, pp. 204-21.

The Cost of Developing a New Drug, Pharmaceutical Manufacturers’ Association, Washington, D.C., 1987, 28 pp.

“Innovation, Market Structure, and Market Dynamics: Comment,” *Journal of Institutional and Theoretical Economics*, March 1986, pp. 200-203.

“The Influence of Private Contractual Failure on Regulation: The Case of Oil Field Unitization,” with G. Libecap, *Journal of Political Economy*, Vol. 93, No. 4, August 1985, pp. 690-714. Reprinted in *The International Library of the New Institutional Economics*, Claude Ménard, Editor, Edward Elgar Publishing Limited, Cheltenham, United Kingdom.

“Oil Field Unitization: Contractual Failure in the Presence of Imperfect Information,” with G. Libecap, *American Economic Review*, Vol. 75, No.3, June 1985, pp. 368-85. Reprint in *Institutional Law and Economics*, Pablo T. Spiller, Editor, *Economic Approaches to Law* series, Francesco Parisi and Richard Posner, Series Editors, Edward Elgar Publishing Limited, Cheltenham, United Kingdom, 2010.

“Contractual Responses to the Common Pool: Prorationing of Crude Oil Production,” with G. Libecap, *American Economic Review*, Vol. 74, No. 1, March 1984, pp. 87-98. Reprint in *The Foundations of Regulatory Economics*, Robert B. Ekelund, Jr., Edward H. Lowder and Catherine L. Lowder, Editors, Edward Elgar Publishing Limited, Cheltenham, United Kingdom. Reprint in *Corporate Reorganization and Bankruptcy: Legal and Financial Materials*, Mark J. Roe, Editor, Foundation Press, 2000.

“Plant Closings, Worker Reallocation Costs, and Efficiency Gains to Labor Representation on Boards of Directors,” with E. Furubotn, *Journal of Institutional and Theoretical Economics*, Vol. 140, No.1, March 1984, pp. 176-92.

“The Effect of U.S. Pharmaceutical Regulation on New Introductions,” *Pharmaceutical Economics*, Bjorn Lindgren, editor, 1984, pp. 191-206.

“Is Regulation Really Necessary When Product Quality is Unknown?,” in A. Shapiro, ed., *Management and Regulation*, The Basis for a Corporate Policy, Stevens Institute of Technology, 1984.

“Quality Uncertainty, Search, and Advertising,” with W.J. Lane, *American Economic Review*, Vol. 73, No. 5, December 1983, pp. 881-94.

“The Impact of Regulation on Pharmaceutical Research Expenditures: A Dynamic Approach,” *Economic Inquiry*, Vol. XXI, January 1983, pp. 115-28.

“Product Quality Regulation and New Drug Introductions: Some New Evidence From the 1970s,” *Review of Economics and Statistics*, Vol. LXIII, No. 4, November 1981, pp. 615-19.

“A Theoretical Analysis of Conglomerate Mergers,” in *The Conglomerate Corporation*, R.D. Blair and R.F. Lanzillotti, editors, Cambridge, Massachusetts, 1981, pp. 53-70.

"The Pharmaceutical Research and Development Decision Process," in *Drugs and Health: Economic Issues and Policy Objectives*, R. Helms, editor, American Enterprise Institute for Public Policy Research, 1981, pp. 55-83.

"Economic Factors Affecting Investment in Planned Birth Technologies," Congressional Office of Technology Assessment, 1980.

PAPERS IN PROGRESS:

"Testing Theories of Price Dispersion and Scarcity Pricing in the Airline Industry," with Steven L. Puller and Anirban Sengupta.

"Pyramidal Ownership in Ecuadorian Business Groups," with Maria L. Granda.

REVIEW RESPONSIBILITIES:

Editorial Board Member:

Journal of Regulatory Economics: 1989-1993.
Journal of Corporate Finance: 1994-2000.

Referee for:

American Economic Review
Applied Economics
Bulletin of Economic Research
Economic Inquiry
Economic Journal
International Economic Review
Journal of Corporate Finance
Journal of Economic Behavior and Organization
Journal of Economics and Management Strategy
Journal of Environmental Economics and Management
Journal of Finance
Journal of Health Economics
Journal of Industrial Economics
Journal of Institutional and Theoretical Economics
Journal of Law and Economics
Journal of Law, Economics, and Organization
Journal of Political Economy
Journal of Regulatory Economics
Journal of the Japanese and International Economies
Managerial and Decision Economics
National Science Foundation
Quarterly Review of Economics and Business
RAND Journal of Economics
Review of Economics and Statistics
Southern Economic Journal

Ph.D. STUDENTS (YEAR OF COMPLETION) DISSERTATION TITLE:

Steve Hackett (1989), *Essays on the Economics of Contracting and Institutional Choice*

Andreas Ortmann (1991), *Essays on Quality Uncertainty, Information, and Institutional Choice*

Robert Maness (1992), *Essays on Organization, Form, and Pricing Behavior*

Hanne Meihuizen (1994), *Three Essays on Contracts*

Wenjie Shi (1997), *An Integrated Approach To The Choice Between Firms, Joint Ventures And Entrepreneurial Enterprises*

Jennifer Vanderhart (2000), *Quality Signals, Word-of-Mouth, and Star Power: The Determinants of Motion Picture Success*

Jun Byoung Oh (2002), *Southwest Airlines and Competition in the Airline Industry*

Ahmed Alwaked (2005), *Estimating Fare and Expenditure Elasticities of Demand for Air Travel in the U.S. Domestic Market*

Jong Ho Kim (2006), *Price Dispersion in The Airline Industry: The Effect Of Industry Elasticity And Cross-Price Elasticity*

Ivan Tasic (2006), *Impact Of Retailers Promotional Activities on Customer Traffic*

Zeynal Karaca (2007) *The Impacts of Break-Through Drug Classes on Total Health Expenditures: Empirical Evidence from the 1996-2001 Medical Expenditure Panel Survey*

Anirban Sengupta (2007) *Airline Pricing, Price Dispersion, and Ticket Characteristics On and Off the Internet*

Maria Granda Kuffo (2009) *Pyramidal Ownership in Ecuadorian Business Groups*

Manuel Hernandez (2009) *Nonlinear Pricing Strategies and Market Concentration in the Airline Industry*

Sung Ick Cho (2012) *Essays on a Monopolist's Product Choice and its Effect on Social Welfare*

Fan Ji (2012) *The Drivers of Mergers and Acquisitions in Pharmaceutical Industry*

José Pellerano (2013) Search *Costs in Airline Markets*

Xiaoyuan Wang (2014) *Essays on Consumer Behavior and Demand Analysis*

Jinkook Lee (2014) *Empirical Essays on the U.S. Airline Industry*

CONFERENCE PRESENTATIONS:

2018

"Algorithmic Pricing and Antitrust," Dallas Bar Association, Dallas, TX.

2010

"Pyramidal Ownership in Ecuadorian Business Firms," Business Association of Latin American Studies, Barcelona, Spain.

1997

The Brookings Institution, Conference on Human Capital and the Theory of the Firm, Washington, D.C.

1996

National Bureau of Economic Research, Summer Institute, sessions on New Approaches to Supply and Demand Analysis and Aging, Health Care and Productivity, Cambridge, MA.

University of Chicago, ELO Workshop, "Information Cascades and Contractual Incompleteness in Natural Gas Contracting, Chicago, IL

University of Wisconsin-Madison, IO Workshop, "Information Cascades and Contractual Incompleteness in Natural Gas Contracting, Madison, WI

1995

National Bureau of Economic Research, Spring IO meetings, "Price Competition in Pharmaceutical Markets," Boston, MA.

1994

American Economic Association, "The Price of Pharmaceuticals," Boston, MA.

Southern Economic Association, "Pricing and Promotion of Pharmaceuticals," New Orleans, LA.

1993

National Bureau of Economic Research, "Cooperation, Coordination, and Collusion Among Firms," Boston, MA.

Harvard Conference on the Pharmaceutical Industry, Boston, MA.

1992

Tenth Annual Seminar on the New Institutional Economics, Wallerfangen, Germany.

Future of the Pharmaceutical Industry: Developments in Market Structure and Technology, MIT.

Editors Conference for the Journal of Regulatory Economics, October 1992.

1991

Annual Meetings of the Pharmaceutical Manufacturers' Association, Session on Models of Pharmaceutical Competition.

Annual Meetings of Southern Economic Association, Session on the Pharmaceutical Industry.

1990

Annual Meetings of the American Economic Association, Session on Experimental Economics Unitization.

Eighth Annual Seminar on the New Institutional Economics, Wallerfangen, Germany.

1989

"Improving the Translation of Research Findings into Clinical Practice: The Changing Economics of Technological Innovation in Medicine" Sponsored by National Academy of Sciences, Washington, DC.

Carnegie-Mellon Conference on Political Economy.

Seventh Annual Conference on the New Institutional Economics in Saarbrucken, West Germany.

Econometric Society Summer Meetings, Ann Arbor, Michigan.

1988

Annual Meetings of the American Economic Association, Session on Endogenous Institutional Choice.

Annual Meetings of the Economic Science Association (Experimental), San Francisco, Sessions on Public Goods Experiments and Experiments on Institutional Choice.

Sixth Annual Conference on the New Institutional Economics, Saarbrucken, Germany

Second Annual Hayek Symposium on Knowledge, Information, and Competition, Freiburg, Germany.

1987

Fifth Annual Conference on the New Institutional Economics, Saarbrucken, Germany.

First Annual Hayek Symposium on Knowledge, Information, and Competition, Freiberg, Germany.
American Economic Association Meetings, Session on Regulation and Long Term Contracts, Chicago.

1986

Econometric Society Meetings, Winter Meetings, New Orleans, Session on Long Term Contracts.

NBER Summer Institute, Cambridge, MA.

Fourth Annual Conference on the New Institutional Economics, Saarbrucken, Germany.

Thirteenth Annual Interlaken Conference, Interlaken, Switzerland.

1985

American Economic Association, Session on Monopoly and Competition, New York.

Third Annual Conference on the New Institutional Economics, Saarbrucken, Germany.

Twelfth Annual Interlaken Conference, Interlaken, Switzerland.

1984

Conference on Management and Regulation: The Basis of a Corporate Policy, sponsored by Stevens Institute of Technology, Hoboken, New Jersey.

Conference on Economics and Philosophy, sponsored by Civitas, Munich.

Second Annual Conference on the New Institutional Economics, sponsored by the Saarlands, Mettlach, Germany.

Eleventh Annual Interlaken Conference, sponsored by the Universities of Bern and Rochester, Interlaken, Switzerland.

1983

Econometric Society Winter Meetings, Billboard Session.

First Annual Conference on the New Institutional Economics, sponsored by the University of the Saarlands, Mettlach, Germany.

1982

Arne Ryde Symposium on Pharmaceutical Economics, Helsingborg, Sweden.

Session on Problems of Industrial Policy, American Economic Association Annual Meeting, December.

1981

Western Economic Association Meetings, Session on Strategic Planning Models, Association

1980

Conference on The Conglomerate Corporation, sponsored by the University of Florida, Gainesville.

1979

Conference on Drugs and Health: Economic Issues and Policy Objectives, American Enterprise Institute, Washington, D.C.

WORKSHOP PRESENTATIONS:

2010

University of Washington, University of Texas at Arlington

1996

University of Wisconsin, University of Chicago, Rice University

1995

Rice University

1994

University of Chicago, UCLA

1993

Penn State, University of Houston, Louisiana State University

1992

Oklahoma State University, University of Pennsylvania

1991

Northwestern University, University of Chicago, Rice University

1990

University of Pennsylvania, Brown University

1989

Harvard, State University of New York-Albany, Massachusetts Institute of Technology, University of Chicago, University of Michigan, Boston University, Columbia University, Northwestern University, University of Indiana, Ohio State, UCLA

1988

University of Chicago, Stanford University, University of California-San Diego, University of Illinois, Washington University, University of Bonn, University of the Saarlands, University of Wurzburg, University of Washington

1987

Virginia Commonwealth University, University of New Orleans, University of Arizona, UCLA, Federal Trade Commission, George Mason University, University of Houston, University of Texas, University of Zurich

1986

Northwestern University, Carnegie Mellon, University of Rochester, Penn State, University of Michigan, University of California-San Diego

1985

Federal Reserve Bank of Dallas, Washington University-St. Louis, Yale University, University of Houston

1984

University of British Columbia, University of Washington, Northwestern University, University of Michigan, Duke University, Yale University

1983

University of Houston, University of Texas

1982

MIT

1981

Federal Trade Commission

Appendix B: Materials Relied Upon

Academic Sources:
Alchian, Armen, "Reliability of Progress Curves in Airframe Production," Working Paper, *RAND Corporation*, 1950.
Almeling, David S., "Seven Reasons Why Trade Secrets are Increasingly Important," *Berkeley Technology Law Journal*, Vol. 27, No. 2, 2012, pp. 1091-1117.
Anderson, Michael L., "Multiple Inference and Gender Differences in the Effects of Early Intervention: A Reevaluation of the Abecedarian, Perry Preschool, and Early Training Projects," *Journal of the American Statistical Association*, Vol. 103, No. 484, 2008, pp. 1481-95.
Angrist, Joshua D. and Jörn-Steffen Pischke, "The Credibility Revolution in Empirical Economics: How Better Research Design Is Taking the Con Out of Econometrics," *Journal of Economic Perspectives,* Vol. 24, No. 3, 2010.
Argote, Linda, Sara L. Beckman, and Dennis Epple, "The Persistence and Transfer of Learning in Industrial Settings," *Management Science*, Vol. 36, No. 2, 1990, pp. 140-154.
Arrow, Kenneth J., "The Economic Implications of Learning by Doing," *The Review of Economic Studies*, Vol. 29, No. 3, 1962, pp. 155-173.
Bandiera, Oriana, Valentino Larcinese, and Imran Rasul, "Blissful ignorance? A natural experiment on the effect of feedback on students' performance," *Labour Economics*, Vol. 34, 2015, pp. 13-25.
Bernkard, Lanier C., "Learning and Forgetting: The Dynamics of Aircraft Production," *American Economic Review*, Vol. 90, No. 4, 2000, pp. 1034-1054.
Bertrand, Marianne, Esther Duflo, and Sendhil Mullainathan, "How Much Should We Trust Difference-in-Differences Estimates?," *Quarterly Journal of Economics*, Vol. 119, No. 1, 2004, pp. 249-275.
Bhargava, Saurabh and Ray Fisman, "Contrast Effects in Sequential Decisions: Evidence from Speed Dating," Review of Economics and Statistics, Vol. 96, No. 3, 2014, pp. 444-457.
Brantingham, Jeffrey P., George Mohler, and John MacDonald, "Changes in public-police cooperation following the murder of George Floyd," *PNAS Nexus*, Vol. 1, No. 5, 2022.
Carrell, Scott E., Bruce I. Sacerdote, and James E. West, "From Natural Variation to Optimal Policy? The Importance of Endogenous Peer Group Formation," *Econometrica*, Vol. 81, No. 3, 2013, pp. 855-882.
Cattaneo, Matias D. and Rocio Titiunik, "Regression Discontinuity Designs," *Annual Review of Economics*, Vol. 14, 2022, pp. 821-851.
Cunningham, Scott, *Causal Inference: The Mixtape*, Yale University Press, 2021, at 252-282, available at https://mixtape.scunning.com/06-regression_discontinuity (last accessed July 25, 2024).
Cunningham, Scott, *Causal Inference: The Mixtape*, Yale University Press, 2021, available at https://mixtape.scunning.com/10-synthetic_control (last accessed July 25, 2024)
Darr, Eric D., Linda Argote, and Dennis Epple, "The Acquisition, Transfer, and Depreciation of Knowledge in Service Organizations: Productivity in franchises," *Management Science*, Vol. 41, No. 11, 1995, pp. 1750-1762.
Doraszelski, Ulrich, Gregory Lewis, and Ariel Pakes, "Just Starting Out: Learning and Equilibrium in a New Market," *American Economic Review*, Vol. 108, No. 3, 2018, pp. 565-615.
Feinstein, Steven and O. Miguel Villanueva, "Securities Litigation Event Studies in the Covid Volatility Regime," *Journal of Forensic Economics*, Vol. 31, No. 1, 2024, pp. 5-25.
Easley, David and Jon Kleinberg, "Chapter 9: Auctions," *Networks, Crowds, and Markets: Reasoning about a Highly Connected World*, Cambridge University Press, 2010, pp. 249-273, available at https://www.cs.cornell.edu/home/kleinber/networks-book/networks-book-ch09.pdf (last accessed July 25, 2024).
Foster, Andrew D. and Mark R. Rosenzweig, "Learning by Doing and Learning from Others: Human Capital and Technical Change in Agriculture," *Journal of Political Economy*, Vol. 103, No. 6, 1995.
Friedman, David D., William M. Landes, and Richard Posner, "Some Economics of Trade Secrets," *Journal of Economic Perspectives*, Vol. 5, No. 1, 1991, pp. 61-72.
Fudenberg, Drew and David K. Levine, "Learning and Equilibrium," *Annual Review of Economics*, Vol. 1, No. 1,

2009, pp. 385–420.
Gelman, Andrew and Guido Imbens, "Why High-Order Polynomials Should Not Be Used in Regression Discontinuity Designs," *Journal of Business & Economic Statistics*, Vol. 37, 2019.
Goke, Shumpei, Gabriel Y. Weintraub, Ralph Mastromonaco, and Sam Seljan, "Bidders' Responses to Auction Format Change in Internet Display Advertising Auctions," Working Paper, January 2022.
Greene, William H., *Econometric Analysis*, Prentice Hall, 7th ed. 2012, at 192-194.
Halvorsen, Robert and Raymond Palmquist, "The Interpretation of Dummy Variables in Semilogarithmic Equations," *American Economic Review*, Vol. 70, 1980, pp. 474-75.
Henderson, James M. and Richard E. Quandt, *Microeconomic Theory: A Mathematical Approach*, McGraw-Hill Book Company, Inc., 3rd ed. 1980, pp. 78-79.
Hortaçsu, Ali, Fernando Luco, Steven L., Puller, and Dongni Zhu, "Does strategic ability affect efficiency? Evidence from electricity markets," *American Economic Review*, Vol. 109, No. 12, 2019, pp. 4302-4342.
Kellog, Ryan, "Learning by Drilling: Interfirm Learning and Relationship Persistence in the Texas Oilpatch," *The Quarterly Journal of Economics*, Vol. 126, No. 4, 2011, pp. 1961-2004.
Knijnenburg, Theo A., Lodewyk F. A. Wessels, Marcel J. T. Reinders, and Ilya Shmulevich, "Fewer permutations, more accurate P-values," *Bioinformatics*, Vol. 25, No. 12, 2009.
List, John A, "Does Market Experience Eliminate Market Anomalies?," *Quarterly Journal of Economics*, Vol. 118, No. 1, 2003, pp. 41-71.
Luca, Michael and Max H. Bazerman, *The Power of Experiments: Decision Making in a Data-Driven World*, Cambridge: MIT Press, 2021.
MacKinnon, James G. and Matthew D. Webb, "Randomization inference for difference-in-differences with few treated clusters," *Journal of Econometrics*, Vol. 218, 2020, pp. 435-450.
Maddala, Gangadharrao S., *Econometrics*, McGraw-Hill College, 1977.
Mankiw, N. Gregory, *Principles of Microeconomics*, Cengage Learning, 5th ed. 2008.
Mankiw, N. Gregory, Ronald D. Kneebone and Kenneth J. McKenzie, *Principles of Microeconomics*, 10th Canadian ed. 2017.
Mankiw, N. Gregory, *Macroeconomics*, Worth Publishers, 7th ed. 2009.
Mattei, Alessandra, Fabrizia Mealli, and Anahita Nodehi, "Design Analysis of Experiments," in Klaus Zimmerman, *Handbook of Labor*, *Human Resources and Population Economics*, Springer, 2022, pp. 1-4 (last accessed July 25, 2024).
McCabe, Mark J., "Principals, Agents, and the Learning Curve: The Case of Steam-Electric Power Plant Design and Construction," *The Journal of Industrial Economics*, Vol. 44, No. 4, 1996, pp. 357-375.
McCrary, Justin, "Manipulation of the running variable in the regression discontinuity design: A density test," *Journal of Econometrics*, Vol. 142, No. 2, 2008, pp. 698-714.
Pownall, Rachel A.J., and Leonard Walk, "Bidding Behavior and Experience in Internet Auctions," *European Economic Review*, Vol. 61, No. 1, 2013, pp. 14-27.
Cass, Ronald A. and Keith N. Hylton, "Trade Secrets," *Laws of Creation*, Harvard University Press, 2013.
Shea, John, "Union Contracts and the Life-Cycle/Permanent-Income Hypothesis," *American Economic Review*, Vol. 85, No. 1, 1995.
Villas-Boas, Sofia B., "An Introduction to Auctions," *Journal of Industrial Organization Education*, Vol. 1, No. 1, 2006, pp. 1-22.
Thompson, Peter, "How Much Did the Liberty Shipbuilders Forget?," *Management Science*, Vol. 53, No. 6, 2007, pp. 908-918.
Thompson, Peter, "Chapter 10 – Learning by Doing," *Handbook of the Economics of Innovation*, Vol. 1, 2010, pp. 429-476.
Verbeek, Marno, *A Guide to Modern Econometrics*, Wiley, 5th ed. 2017.
Xin, Wang, and Ye Hu, "The Effect of Experience on Internet Auction Bidding Dynamics," *Marketing Letters*, Vol. 20, No. 3, 2009, pp. 245–261.
Wieland, Volker, "Learning by Doing and the Value of Optimal Experimentation," *Journal of Economic Dynamics and Control*, Vol. 24, 2000, pp. 501-534.
Bates Numbered Documents, Beginning Bates Number: *(includes datasets)*
AAG001661

[redacted]
GOOG-AT-DOJ-DATA-000000001
GOOG-AT-DOJ-DATA-000011657
GOOG-AT-DOJ-DATA-000066789
GOOG-AT-EDTX-DATA-001116099
GOOG-AT-EDTX-DATA-001116100
GOOG-AT-EDTX-DATA-001116101
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GOOG-AT-MDL-004248075
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GOOG-AT-MDL-008932468
GOOG-AT-MDL-008991451
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GOOG-AT-MDL-009644018
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GOOG-AT-MDL-C-000017971
GOOG-AT-MDL-C-000021794
GOOG-AT-MDL-C-000035248
GOOG-AT-MDL-C-000035251
GOOG-AT-MDL-DATA-000066537
GOOG-AT-MDL-DATA-000486626
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GOOG-DOJ-03071474
GOOG-DOJ-03258376
GOOG-DOJ-03998505
GOOG-DOJ-04306227
GOOG-DOJ-04306227
GOOG-DOJ-04934481
GOOG-DOJ-04937154
GOOG-DOJ-04937543
GOOG-DOJ-05244355
GOOG-DOJ-05283173
GOOG-DOJ-05311280
GOOG-DOJ-06842351
GOOG-DOJ-06842351
GOOG-DOJ-07235914
GOOG-DOJ-07960537
GOOG-DOJ-11247631
GOOG-DOJ-12439154
GOOG-DOJ-12700489
GOOG-DOJ-13199480
GOOG-DOJ-13199603
GOOG-DOJ-13204873
GOOG-DOJ-13208074
GOOG-DOJ-13212948
GOOG-DOJ-13220040
GOOG-DOJ-13235100
GOOG-DOJ-13330569
GOOG-DOJ-13350192
GOOG-DOJ-13370181
GOOG-DOJ-13469175
GOOG-DOJ-13469175
GOOG-DOJ-13470118
GOOG-DOJ-13625417

GOOG-DOJ-13949282
GOOG-DOJ-14030931
GOOG-DOJ-14037639
GOOG-DOJ-14550102
GOOG-DOJ-14717283
GOOG-DOJ-14718514
GOOG-DOJ-14734878
GOOG-DOJ-14735882
GOOG-DOJ-15068390
GOOG-DOJ-15130321
GOOG-DOJ-15426012
GOOG-DOJ-15719056
GOOG-DOJ-29803801
GOOG-DOJ-AT-01509210
GOOG-DOJ-AT-02467209
GOOG-TEX-00144513
GOOG-TEX-00585243
GOOG-TEX-00982249
GOOG-TEX-00993980
[redacted]
[redacted]31
[redacted]

[redacted]
Court Documents:
Defendant Google LLC's First Amended Responses and Objections to Plaintiffs' Third Set of Interrogatories, May 24, 2024
Defendant Google LLC's Responses and Objections to Plaintiffs' Second Set of Interrogatories, April 8, 2024
Defendant Google LLC's Supplemental Response to Plaintiffs' Second Set of Interrogatories, May 3, 2024
Fourth Amended Complaint, *State of Texas, et al. v. Google LLC*, 4:20-cv-00957-SDJ (E.D. Tex. May 5, 2023)
Google LLC's Motion to Dismiss Pursuant to Rule 12(b)(6), *State of Texas et al. v. Google LLC*, No. 4:20-cv-00957-SDJ (E.D. Tex. Feb. 8, 2024), ECF No. 224
Second Amended Complaint, *In re Google Digital Advertising Litigation*, No. 1:21-md-03010-PKC (S.D.N.Y. Oct. 22, 2021), ECF No. 152.
Oracle Corporation, Draft Complaint, *In the Matter of Alphabet, Inc.*, May 8, 2023
Plaintiff States' Response in Opposition to Google LLC's Motion to Dismiss Under Rule 12(b)(6), *State of Texas et al. v. Google LLC*, No. 4:20-cv-00957-SDJ (E.D. Tex. Feb. 21, 2024), ECF No. 260-1.
Plaintiffs' Unopposed Motion for Final Approval of Class Action Settlement, *Brown et al. v. Google LLC*, No. 4:20-cv-03664 (N.D. Cal. Apr. 1, 2024), ECF No. 1096.
Findings of Fact and Conclusions of Law Re Chat Preservation, *In Re Google Play Store Antitrust Litigation*, Case No. 3:21-md-02981-JD (N.D. Cal. Mar. 28, 2023), ECF No. 469.
Depositions:
30(b)(1) Deposition of [redacted] (Google), November 15, 2023
[redacted]
30(b)(1) Deposition of [redacted] (Google), April 25, 2024
30(b)(6) Deposition of [redacted] (Google), April 26, 2024
[redacted]

[redacted]
Expert Reports:
Expert Report of Douglas Skinner, July 30, 2024
Expert Report of Itamar Simonson, July 30, 2024
Expert Report of Jeffery S. Andrien, June 7, 2024
Expert Report of Joshua Gans, June 7, 2024
Expert Report of Matthew Weinberg, June 7, 2024
Expert Report of Parag Pathak, June 7, 2024
Letters:
W. Noss and Z. DeRose, "Re: *In re: Google Digital Advertising Antitrust Litigation*, No. 1:21-md-03010 (PKC), *State of Texas, et al. v. Google LLC*, No. 4:20-cv-00957-SDJ," May 3, 2024
W. Noss and Z. DeRose, "Re: *The State of Texas, et al. v. Google LLC*, Case No. 4:20-cv-00957-SDJ (E.D. Tex.)," March 29, 2024
Weblinks:
"2016 releases archive: DoubleClick for Publishers and Ad Exchange Seller," *Google Ad Manager Help*, June 13, 2016, available at https://support.google.com/admanager/answer/7421657?sjid=10086602547051235141-NA#zippy=%2Cjune-change-history-update-safeframe-for-creative-types-deal-check-bid-filter-apply-per-query-revenue-share-optimization. (last accessed July 25, 2024) (under the Q2 2016 Ad Exchange release stating "New Ad Exchange control for applying per-query revenue share optimization")
"2022 Google Ad Manager releases archive," *Google Ad Manager Help*, June 6, 2022, available at https://support.google.com/admanager/answer/11586212 (last accessed July 25, 2022).
"About Automated Bidding," *Google*, available at https://support.google.com/google-ads/answer/2979071?hl=en (last accessed July 25, 2024).
"About bidding on impressions," *Google*, available at https://support.google.com/google-ads/answer/2630842?hl=en (last accessed July 25, 2024).
"About optimization score," *Google Ads Help*, available at https://support.google.com/google-ads/answer/9061546 (last accessed July 25, 2024).
"About Target CPA bidding," *Google*, available at https://support.google.com/google-ads/answer/6268632?hl=en (last accessed July 25, 2024).
"About target ROAS bidding," *Google*, available at https://support.google.com/google-ads/answer/6268637?hl=en (last accessed July 25, 2024).
"Ad Manager Data Transfer reports," *Google Ad Manager Help*, available at https://support.google.com/admanager/answer/1733124 (last accessed on July 25, 2024).
"Ad Manager report metrics," *Google Ad Manager Help*, available at https://support.google.com/admanager/table/7568664 (last accessed July 25, 2024).
"Advertiser analytics," *Microsoft Xandr Platform*, March 5, 2024, available at https://learn.microsoft.com/en-us/xandr/digital-platform-api/advertiser-analytics (last accessed July 25, 2024).
"Amazon DSP: Your brand in new places," *Amazon*, available at https://advertising.amazon.com/solutions/products/amazon-dsp (last accessed July 25, 2024).
"Appendix G: the role of tracking in digital advertising," in *Online platforms and digital advertising market study*, United Kingdom Competition and Markets Authority, 2020, available at https://assets.publishing.service.gov.uk/media/5fe49554e90e0711ffe07d05/Appendix_G_-_Tracking_and_PETS_v.16_non-confidential_WEB.pdf (last accessed July 25, 2024).

"Are you leaving Ad Revenue on the table?," *MonetizeMore*, available at https://www.monetizemore.com/# (last accessed July 25, 2024).
"Campaign," *The Trade Desk*, available at https://partner.thetradedesk.com/v3/portal/api/doc/Campaign (last accessed July 25, 2024).
"Choose a bid amount that works for you," *Google*, available at https://support.google.com/google-ads/answer/2471184?hl=en (last accessed July 25, 2024).
"Comcast buys advertising startup Freewheel for $360 million," *Reuters*, March 6, 2014, available at https://www.reuters.com/article/idUSL1N0M31GL/ (last accessed July 25, 2024).
"Conversion Tracking: Definition," *Google*, available at https://support.google.com/google-ads/answer/6308 (last accessed July 25, 2024).
"Cost per action (CPA)," *AppsFlyer*, available at https://www.appsflyer.com/glossary/cpa/ (last accessed July 25, 2024)
"Cost Per Click (CPC) Explained, With Formula and Alternatives," *Investopedia*, June 28, 2023, available at https://www.investopedia.com/terms/c/cpc.asp (last accessed July 25, 2024).
"Demand Side Platform: Achieve your marketing goals," *The Trade Desk*, available at https://www.thetradedesk.com/us/our-platform/dsp-demand-side-platform (last accessed July 25, 2024).
"Discounting for Public Policy: Theory and Recent Evidence on the Merits of Updating the Discount Rate," *Council of Economic Advisers Issue Brief*, January 2017, available at https://obamawhitehouse.archives.gov/sites/default/files/page/files/201701_cea_discounting_issue_brief.pdf (last accessed July 25, 2024).
"Display & Video 360 Help: Total Media Cost," *Google*, available at https://support.google.com/displayvideo/answer/3007271?hl=en (last accessed July 25, 2024).
"For Sellers: SupplySuite," *FreeWheel*, available at https://www.freewheel.com/supplysuite (last accessed July 25, 2024).
"Forecasting," *Inventale*, available at https://inventale.com/en/forecasting/ (last accessed July 26, 2024).
"Google Marketing Platform," *Google*, available at https://marketingplatform.google.com/about/ (last accessed July 25, 2024).
"How can you optimize your digital ads?," *LinkedIn*, available at https://www.linkedin.com/advice/3/how-can-you-optimize-your-digital-ads-skills-advertising (last accessed July 26, 2024).
"How do you know if your marketing campaigns are successful?," *Hotjar*, May 11, 2023, available at https://www.hotjar.com/blog/marketing-campaign-success/ (last accessed July 25, 2024).
"How to choose the right ad objective in Meta Ads Manager," *Meta Business Help Center*, available at https://www.facebook.com/business/help/1438417719786914 (last accessed July 25, 2024).
"How to Optimize Ad Campaigns: What You Need to Know," *TEC Direct Media*, available at https://tec-direct.com/how-to-optimize-ad-campaigns-what-you-need-to-know/ (last accessed on July 25, 2024).
"How to use Audience performance report," *Criteo*, available at https://help.criteo.com/kb/guide/en/audience-performance-report-9sG6Wef3qz/Steps/775752,1863384 (last accessed July 25, 2024).
"Inventory basics: What is inventory?," *Google*, available at https://support.google.com/admanager/answer/10064557 (last accessed July 25, 2024).
"Make every use worth more," *Verve Group*, available at https://verve.com/publishers/ (last accessed July 25, 2024).
"Marketing Effectiveness," *Dentsu*, available at https://www.dentsu.com/uk/en/marketing-effectiveness (last accessed July 25, 2024).
"Maxifier for Publishers," *Maxifier*, available at https://maxifier.com/maxifier-for-publishers/ (last accessed July 25, 2024).
"Maximize Revenue, Minimize Hassle," *Clickio*, available at https://clickio.com/monetization/ (last accessed July 25, 2024).
"Measure results," *Google Ads Help*, available at https://support.google.com/google-ads/topic/3119141 (last accessed July 25, 2024).
"Metrics in reports," *Google Display & Video 360 Help*, available at https://support.google.com/displayvideo/table/3187025 (last accessed July 25, 2024).
"Microsoft Invest – Set up line item optimization," *Xandr Platform*, February 19, 2024, available at https://learn.microsoft.com/en-us/xandr/invest/set-up-line-item-optimization (last accessed July 25, 2024).
"Microsoft Monetize – Charges for buyers," *Xandr Platform*, February 26, 2024, available at

https://learn.microsoft.com/en-us/xandr/monetize/charges-for-buyers (last accessed July 25, 2024).
"Monitoring," *Inventale*, available at https://inventale.com/en/monitoring/ (last accessed July 25, 2024).
"One demand-side platform to rule them all," *Adobe*, available at https://business.adobe.com/products/advertising/demand-side-platform.html (last accessed July 25, 2024).
"Optimization buying strategies," *Microsoft Xandr Platform*, available at https://learn.microsoft.com/en-us/xandr/monetize/optimization-buying-strategies (last accessed July 25, 2024).
"Poll: Americans Want Free Internet Content, Value Interest-Based Advertising," *American Association of Advertising Agencies*, April 18, 2023, available at https://www.aaaa.org/pollamericanswantfreeinternetcontentvalueinterest-basedadvertising/ (last accessed July 25, 2024).
"PPC Reporting Capabilities," *Optmyzer*, available at https://www.optmyzr.com/solutions/reporting (last accessed July 25, 2024).
"PubTalk: PCH's Denise Leggio on winning big with DoubleClick Ad Exchange," *DoubleClick Publisher Blog*, April 24, 2012, available at https://doubleclick-publishers.googleblog.com/2012/04/ (last accessed July 25, 2024).
"Real-time bidding (RTB)," *Clearcode*, available at https://clearcode.cc/glossary/real-time-bidding-rtb/ (last accessed July 25, 2024).
"Set budgets and control your pacing," *Google*, available at https://support.google.com/displayvideo/answer/3114676?hl=en (last accessed July 25, 2024).
"Smart Advertising Analytics: To turn insights into revenue," *Adomik*, available at https://www.adomik.com/ (last accessed July 25, 2024).
"Sponsored Display custom bid optimizations," *AmazonAds*, available at https://advertising.amazon.com/library/guides/sponsored-display-custom-bid-optimizations (last accessed July 25, 2024).
"Statement of the Department of Justice's Antitrust Division on Its Decision to Close Its Investigation of Google Inc.'s Acquisition of Admeld Inc.," *Department of Justice*, December 2, 2011, available at https://www.justice.gov/opa/pr/statement-department-justices-antitrust-division-its-decision-close-its-investigation-google (last accessed July 25, 2024).
"Take your PPC automation to the next level," *Adalysis*, available at https://adalysis.com/features/ (last accessed July 25, 2024).
"Targeting and Optimization," *The Trade Desk*, available at https://partner.thetradedesk.com/v3/portal/api/doc/TargetingOptimizationOverview (last accessed July 25, 2024).
"The History of Digital Advertising Technology," *Clearcode*, available at https://adtechbook.clearcode.cc/history-advertising-technology/ (last accessed July 25, 2024).
"Top 10 Retargeting Acronyms to Help You Crush Your Campaigns," *Criteo*, available at https://www.criteo.com/wp-content/uploads/2017/07/Report-criteo-the-smart-marketers-guide-to-retargeting-acronyms-one-pager.pdf (last accessed July 25, 2024).
"Use auction insights to compare performance," *Google Ads Help*, available at https://support.google.com/google-ads/answer/2579754 (last accessed July 25, 2024).
"Vocento Enters Partnership with Smart," *ExchangeWire*, January 5, 2022, available at https://www.exchangewire.com/blog/2022/01/05/vocento-enters-partnership-with-smart/ (last accessed July 25, 2024).
"What is a Supply-Side Platform (SSP)? Here's everything you need to know," *AmazonAds*, available at https://advertising.amazon.com/library/guides/supply-side-platform (last accessed July 25, 2024).
"What is Operating Profit? Everything You Need to Know," *American Express,* May 22, 2024, available at https://www.americanexpress.com/en-gb/business/trends-and-insights/articles/what-is-operating-profit/ (last accessed July 27, 2024).
"What is Predictive Bidding," *Criteo*, available at https://www.criteo.com/technology/predictive-bidding (last accessed July 25, 2024).
"What is Targeted Advertising?," *GCF Global*, available at https://edu.gcfglobal.org/en/thenow/what-is-targeted-advertising/1/ (last accessed July 25, 2024).
"What You Need to Know About First-Price Auctions and Criteo," *Criteo*, September 12, 2019, available at https://www.criteo.com/blog/first-price-auctions (last accessed July 25, 2024).
"Yield Management," *Inventale*, available at https://inventale.com/en/yield-management/ (last accessed July 25, 2024).

"Your Programmatic Media Partner," *MiQ*, available at https://www.wearemiq.com/ (last accessed July 25, 2024).
"Your site is unique. Your ad optimization should be too," *MonetizeMore*, available at https://www.monetizemore.com/# (last accessed July 25, 2024).
"2016 releases archive: DoubleClick for Publishers and Ad Exchange Seller," *Google Ad Manager Help*, available at https://support.google.com/admanager/answer/7421657?sjid=10086602547051235141-NA#zippy=%2Cjune-change-history-update-safeframe-for-creative-types-deal-check-bid-filter-apply-per-query-revenue-share-optimization (last accessed July 25, 2024).
"AdWords for video makes reporting more insightful, purposeful and beautiful," *Google*, January 30, 2013, available at https://adwords.googleblog.com/2013/01/ (last accessed July 25, 2024).
"AEPD Hands Google 10M Euro GDPR Fine," *IAPP*, May 18, 2022, available at https://iapp.org/news/a/aepd-hands-google-10m-euro-gdpr-fine/ (last accessed July 25, 2024).
"AG Ferguson: Google Will Pay More Than $423,000 Over Repeated Violations of Washington Campaign Finance Law," *Washington State Office of the Attorney General*, June 17, 2021, available at https://www.atg.wa.gov/news/news-releases/ag-ferguson-google-will-pay-more-423000-over-repeated-violations-washington (last accessed July 25, 2024).
Alphabet Inc. Form 10-K for the fiscal year ended December 31, 2023, *Alphabet Investor Relations*, 2024, at 35, available at https://abc.xyz/assets/43/44/675b83d7455885c4615d848d52a4/goog-10-k-2023.pdf (last accessed July 26, 2024).
"Antitrust: Commission Fines Google €1.49 Billion for Abusive Practices in Online Advertising," *European Commission*, March 20, 2019, available at https://ec.europa.eu/commission/presscorner/detail/en/IP_19_1770 (last accessed July 25, 2024).
"Antitrust: Commission Fines Google €2.42 Billion for Abusing Dominance as Search Engine by Giving Illegal Advantage to Own Comparison Shopping Service," *European Commission*, June 27, 2017, available at https://ec.europa.eu/commission/presscorner/detail/en/IP_17_1784 (last accessed July 25, 2024).
"Attorney General Mark Brnovich Achieves Historic $85 Million Settlement with Google," *Arizona State Office of the Attorney General*, October 4, 2022, available at https://www.azag.gov/press-release/attorney-general-mark-brnovich-achieves-historic-85-million-settlement-google (last accessed July 25, 2024).
Beattie, Andrew, "How to Calculate the Return on Investment (ROI) of a Marketing Campaign," *Investopedia*, July 4, 2024, available at https://www.investopedia.com/articles/personal-finance/053015/how-calculate-roi-marketing-campaign.asp (last accessed July 25, 2024).
"Belgian DPA Imposes €600.000 Fine on Google Belgium for not Respecting the Right to be Forgotten of a Belgian Citizen, and for Lack of Transparency in its Request Form to Delist," *European Data Protection Board*, July 16, 2020, available at https://www.edpb.europa.eu/news/national-news/2020/belgian-dpa-imposes-eu600000-fine-google-belgium-not-respecting-right-be_en (last accessed July 25, 2024).
Bellack, Jonathan, "Smarter optimizations to support a healthier programmatic market," *Google Ad Manager Blog*, May 12, 2016, available at https://blog.google/products/admanager/smarter-optimizations-to-suppor/ (last accessed July 26, 2024).
Bender, Gabe, "Dynamic Price Floors: A Call For Standardization," *AdExchanger*, June 3, 2016, available at https://www.adexchanger.com/the-sell-sider/dynamic-price-floors-call-standardization/ (last accessed July 26, 2024).
Ben-Meir, Kobi, "Five Key Marketing Metrics For Savvy Small- And Medium-Sized Business Owners," *Forbes*, April 19, 2023, available at https://www.forbes.com/sites/forbescommunicationscouncil/ 2023/04/19/five-key-marketing-metrics-for-savvy-smalland-medium-sized-business-owners/ (last accessed July 25, 2024).
Kalra, Aditya and Aditi Shah, "Competition Commission of India Fines Google for Abusing Dominant Position," *Reuters*, February 8, 2018, available at https://www.reuters.com/article/india-google-antitrust-idINKBN1FS29Z/ (last accessed July 25, 2024).
"CPC (Cost per Click) explained," *Amazon*, available at https://advertising.amazon.com/library/guides/cost-per-click (last accessed July 25, 2024).
Dougherty, Sean, "Ad campaign optimization: six strategies for success," *Funnel*, February 21, 2023, available at https://funnel.io/blog/six-ad-campaign-optimizations (last accessed July 25, 2024).
"Enforcement Bureau Issues $25,000 NAL to Google Inc," *Federal Communications Commission*, File No. EB-10-IH-4055, April 13, 2012, available at https://docs.fcc.gov/public/attachments/DA-12-592A1.pdf (last accessed July 25, 2024).
Bagatsky, Eugene, "Best Ad Servers for Publishers (in 2022)," *Snigel*, January 20, 2022, available at

https://snigel.com/blog/best-ad-servers-for-publishers (last accessed July 25, 2024).
"Facebook will shut down Facebook Audience Network's mobile web arm," *Digiday*, February 5, 2020, available at https://digiday.com/media/facebook-plans-shut-facebook-audience-networks-mobile-web-arm/ (last accessed July 25, 2024).
Ford, Clay, "Interpreting Log Transformations in a Linear Model," *University of Virginia Library*, August 17, 2018, available at https://library.virginia.edu/data/articles/interpreting-log-transformations-in-a-linear-model (last accessed July 25, 2024).
Rosemain, Mathieu, "France Fines Google $57 Million for European Privacy Rule Breach," *Reuters*, January 21, 2019, available at https://www.reuters.com/article/us-google-privacy-france/france-fines-google-57-million-for-european-privacy-rule-breach-idUSKCN1PF208/ (last accessed July 25, 2024).
Fioretti, Julia, "France Fines Google Over 'Right to Be Forgotten'," *Reuters*, March 24, 2016, available at https://www.reuters.com/article/idUSKCN0WQ1WX/ (last accessed July 25, 2024).
Brian, Matt, "France Slaps Google with $204,000 Fine for Violating Privacy Laws," *Engadget*, January 8, 2014, https://www.engadget.com/2014-01-08-google-privacy-cnil-fine.html (last accessed July 25, 2024).
Lomas, Natasha, "France Spanks Google $170M, Facebook $68M Over Cookie Consent Dark Patterns," *TechCrunch*, January 6, 2022, available at https://techcrunch.com/2022/01/06/cnil-facebook-google-cookie-consent-eprivacy-breaches/ (last accessed July 25, 2024).
Atwill, Nicole, "France: Google Fined by National Commission on Information Technology and Liberty," *Library of Congress*, March 25, 2011, available at https://www.loc.gov/item/global-legal-monitor/2011-03-25/france-google-fined-by-national-commission-on-information-technology-and-liberty/ (last accessed July 25, 2024).
"FTC, States Sue Google and iHeartMedia for Deceptive Ads Promoting the Pixel 4 Smartphone," *Federal Trade Commission*, November 28, 2022, available at https://www.ftc.gov/news-events/news/press-releases/2022/11/ftc-states-sue-google-iheartmedia-deceptive-ads-promoting-pixel-4-smartphone (last accessed July 25, 2024).
"German State Fines Google for Street View Data Breach," *Reuters*, April 22, 2013, available at https://www.reuters.com/article/google-privacy/german-state-fines-google-for-street-view-data-breach-idINDEE93L0ED20130422/ (last accessed July 25, 2024).
"Spain Privacy Watchdog Fines Google for Breaking Data Law," *Reuters*, December 19, 2013, available at https://www.reuters.com/article/us-spain-google-privacy/spain-privacy-watchdog-fines-google-for-breaking-data-law-idUSBRE9BI12Z20131219/ (last accessed July 25, 2024).
Global Settlement Agreement, Balderas v. Tiny Lab Productions, et al., No. 1:18-cv-00854-MV-JFR, Balderas v. Google LLC, No. 1:20-cv-00143-NF-KHR, December 10, 2021, available at https://business.cch.com/CybersecurityPrivacy/GoogleNMSettlement.pdf (last accessed July 25, 2024).
"Glossary," *eMarketer*, available at https://totalaccess.emarketer.com/thesaurus.aspx (last accessed July 29, 2024).
Google Ads ("Cost-per-click (CPC): Definition," *Google*, available at https://support.google.com/google-ads/answer/116495?hl=en (last accessed July 25, 2024).
Alba, Davey, "Google Agrees to Delete Users' 'Incognito' Browsing Data in Lawsuit Settlement," *TIME*, April 1, 2024, https://time.com/6962521/google-incognito-lawsuit-data-settlement/ (last accessed July 25, 2024).
"Google and YouTube Will Pay Record $170 Million for Alleged Violations of Children's Privacy Law," *Federal Trade Commission*, September 4, 2019, available at https://www.ftc.gov/news-events/news/press-releases/2019/09/google-youtube-will-pay-record-170-million-alleged-violations-childrens-privacy-law (last accessed July 25, 2024).
Kalra, Aditya and Munsif Vengattil, "Google Fined $162 mln by India Antitrust Watchdog for Abuse of Android Platform," *Reuters*, October 20, 2022, available at https://www.reuters.com/world/india/india-competition-regulator-fines-google-16195-mln-anti-competitive-practices-2022-10-20/ (last accessed July 25, 2024).
Kang, Cecilia, "Google Agrees to $392 Million Privacy Settlement With 40 States," *The New York Times*, November 14, 2022, available at https://www.nytimes.com/2022/11/14/technology/google-privacy-settlement.html (last accessed July 30, 2024).
"Google Fined £91m Over Ad-Tracking Cookies," *BBC*, December 10, 2020, available at https://www.bbc.com/news/technology-55259602 (last accessed July 25, 2024).
"Google Forfeits $500 Million Generated by Online Ads & Prescription Drug Sales by Canadian Online Pharmacies," *U.S. Department of Justice*, August 24, 2011, available at https://www.justice.gov/opa/pr/google-forfeits-500-million-generated-online-ads-prescription-drug-sales-canadian-online (last accessed July 25, 2024).
Richards, Matt, "Google Hit by Android Fine in Turkey," *Global Competition Review*, September 21, 2018, available at https://globalcompetitionreview.com/article/google-hit-android-fine-in-turkey (last accessed July 25,

2024).
Scarcella, Mike, "Google Hit with $971,000 Sanction for Litigation Misconduct in Privacy Suit," *Reuters*, July 18, 2022, available at https://www.reuters.com/legal/transactional/google-hit-with-971k-sanction-litigation-misconduct-privacy-suit-2022-07-15/ (last accessed July 25, 2024).
"Google LLC to Pay $60 Million for Misleading Representations," *Australian Competition & Consumer Commission*, August 12, 2022, available at https://www.accc.gov.au/media-release/google-llc-to-pay-60-million-for-misleading-representations (last accessed July 25, 2024).
Reid, Jenni, "Google Loses Appeal Over EU Antitrust Ruling, But Fine Cut to $4.12 Billion," *CNBC*, September 14, 2022, available at https://www.cnbc.com/2022/09/14/eu-court-backs-antitrust-ruling-against-google-but-reduces-fine.html (last accessed July 25, 2024).
Perez, Sarah, "Google Reaches $7.8 Million Settlement in its Android Antitrust Case in Russia," *TechCrunch*, April 17, 2017, available at https://techcrunch.com/2017/04/17/google-reaches-7-8-million-settlement-in-its-android-antitrust-case-in-russia/ (last accessed July 25, 2024).
Miller, Claire C., "Google to Pay $17 Million to Settle Privacy Case," *New York Times*, November 18, 2013, available at https://www.nytimes.com/2013/11/19/technology/google-to-pay-17-million-to-settle-privacy-case.html (last accessed July 25, 2024).
Gans, Jared, "Google to pay $29.5 Million to Settle DC, Indiana Lawsuits Over Location Tracking," *The Hill*, December 31, 2022, available at https://thehill.com/policy/technology/3794301-google-to-pay-29-5-million-to-settle-dc-indiana-lawsuits-over-location-tracking/ (last accessed July 25, 2024).
"Google to Pay $7 million in Multistate Settlement over Street View," *Washington State Office of the Attorney General*, March 11, 2013, available at https://www.atg.wa.gov/news/news-releases/google-pay-7-million-multistate-settlement-over-street-view (last accessed July 25, 2024).
"Google to Pay Indiana $20 Million to Resolve Tracking Privacy Lawsuit," *PBS News*, December 30, 2022, available at https://www.pbs.org/newshour/economy/google-to-pay-indiana-20-million-to-resolve-tracking-privacy-lawsuit (last accessed July 25, 2024).
"Google Will Pay $22.5 Million to Settle FTC Charges it Misrepresented Privacy Assurances to Users of Apple's Safari Internet Browser," *Federal Trade Commission*, August 9, 2012, available at https://www.ftc.gov/news-events/news/press-releases/2012/08/google-will-pay-225-million-settle-ftc-charges-it-misrepresented-privacy-assurances-users-apples (last accessed July 25, 2024).
"Google, Facebook to Pay More Than $400k to Washington State in Campaign Finance Cases," *Washington State Office of the Attorney General*, December 18, 2018, available at https://www.atg.wa.gov/news/news-releases/google-facebook-pay-more-400k-washington-state-campaign-finance-cases (last accessed July 25, 2024).
"Guide to programmatic advertising: Market, types, and buying process explained," *eMarketer*, February 14, 2024, available at https://www.emarketer.com/insights/programmatic-digital-display-ad-spending/ (last accessed July 25, 2024).
Hayes, Adam, "Click-Through Rate (CTR): Definition, Formula, and Analysis," *Investopedia*, December 22, 2022, available at https://www.investopedia.com/terms/c/clickthroughrates.asp (last accessed July 25, 2024).
Horwitz, Jeff and Keach Hagey, "Google's Secret 'Project Bernanke' Revealed in Texas Antitrust Case," *The Wall Street Journal*, April 11, 2021, available at https://www.wsj.com/articles/googles-secret-project-bernanke-revealed-in-texas-antitrust-case-11618097760 (last accessed July 25, 2024).
Hutchinson, Emma, *Principles of Microeconomics*, OpenStax CNX, May 18, 2016, available at https://ecampusontario.pressbooks.pub/uvicmicroeconomics/ (last accessed July 25, 2024).
Paramasivam, Praveen and Aditya Kalra, "India Orders Google to Allow Third-Party Payments, Slaps on Another Fine," *Reuters*, October 26, 2022, available at https://www.reuters.com/technology/india-fines-google-113-million-second-antitrust-penalty-this-month-2022-10-25/ (last accessed July 25, 2024).
"Italy fines Google for excluding Enel e-car app from Android Auto," *Reuters*, May 13, 2021, available at https://www.reuters.com/technology/italys-antitrust-fines-google-102-million-euros-abuse-dominant-position-2021-05-13/ (last accessed July 25, 2024).
Levine, Barry, "Italy Slaps Google's Hand with $1.4M Fine for not Clearly Labeling Street View Cars," *Venture Beat*, April 4, 2014, available at https://venturebeat.com/business/italy-slaps-googles-hand-with-1-4m-fine-for-not-labeling-street-view-cars/ (last accessed July 25, 2024).
"Italy's Antitrust Regulator Fines Google, Apple Over Data Use," *Reuters*, November 29, 2021, available at https://www.reuters.com/technology/italys-antitrust-fines-google-apple-commercial-use-data-2021-11-26/ (last accessed July 25, 2024).

Bigler, Jason, "Rolling out first price auctions to Google Ad Manager partners," *Google Ad Manager Blog*, September 5, 2019, available at https://blog.google/products/admanager/rolling-out-first-price-auctions-google-ad-manager-partners/ (last accessed July 25, 2024).
Lyden, Carolyn, "Google allegedly creates ad monopoly with Facebook to favor its own exchange according to new, unredacted details from Project Jedi," *Search Engine Land*, October 25, 2021, available at https://searchengineland.com/google-allegedly-creates-ad-monopoly-with-facebook-to-favor-its-own-exchange-according-to-new-unredacted-details-from-project-jedi-375487 (last accessed July 25, 2024).
Wlosik, Michal and Maciej Zawadziński, "What Is a Supply-Side Platform (SSP) and How Does It Work?," *Clearcode*, January 31, 2024, available at https://clearcode.cc/blog/what-is-supply-side-platform/ (last accessed July 25, 2024).
Marvin, Ginny, "Google is Retiring the AdWords & DoubleClick Brands in a Major Rebranding Aimed at Simplification," *Search Engine Land*, June 27, 2018, available at https://searchengineland.com/google-is-retiring-the-adwords-doubleclick-brands-in-a-major-rebranding-aimed-at-simplification-301073 (last accessed July 25, 2024).
Mayer, Tim, "ROI Vs. ROAS: Which Is The Better Metric For Digital Advertisers?," *AdExchanger*, February 13, 2015, available at https://www.adexchanger.com/data-driven-thinking/roi-vs-roas-which-is-the-better-metric-for-digital-advertisers/ (last accessed July 25, 2024).
"Introducing Meta Audience Network: New Name, Same Partnership with Publishers," *Meta Audience Network Blog,* November 12, 2021, available at https://www.facebook.com/audiencenetwork/resources/blog/introducing-meta-audience-network (last accessed July 25, 2024).
Meyer, Elyse F., "Five Ways To Optimize Your Digital Marketing Strategy," *Forbes*, April 15, 2021, available at https://www.forbes.com/sites/forbesagencycouncil/2021/04/15/five-ways-to-optimize-your-digital-marketing-strategy/ (last accessed July 25, 2024).
Nix, Naomi, "Oracle's Hidden Hand is Behind the Google Antitrust Lawsuits," *Los Angeles Times*, December 24, 2020, available at https://www.latimes.com/business/story/2020-12-24/oracle-google-antitrust-lawsuits (last accessed July 25, 2024).
Naylon, Jenna, "Media Planning and Buying Strategies: The Importance of Test & Learn," *MatrixPoint*, available at https://www.thematrixpoint.com/resources/articles/media-planning-and-buying-strategies-the-importance-of-test-learn (last accessed July 25, 2024).
Nelson, Marisa, "Smart AdServer Rebrands as Equativ," *Equativ*, June 8, 2022, available at https://equativ.com/blog/press-release/smart-adserver-rebrands-as-equativ/ (last accessed July 25, 2024).
Nichols, Wes, "Advertising Analytics 2.0," *Harvard Business Review*, 2013, available at https://hbr.org/2013/03/advertising-analytics-20 (last accessed July 25, 2024).
Picard, Eric, "Publishers, Don't Settle for Below-Floor Pricing," *AdExchanger*, November 1, 2023, available at https://www.adexchanger.com/the-sell-sider/publishers-dont-settle-for-below-floor-pricing/ (last accessed July 25, 2024).
"Process the Request," *Google Authorized Buyers*, available at https://developers.google.com/authorized-buyers/rtb/request-guide (last accessed July 25, 2024).
Raehsler, Lisa, "What is a Good CTR? Is Your Click-Through Rate Good Enough?," *Agency Analytics*, May 19, 2023, available at https://agencyanalytics.com/blog/average-click-through-rate (last accessed July 25, 2024).
Ramaswamy, Sridhar, "Introducing simpler brands and solutions for advertisers and publishers," *Google*, June 27, 2018, available at https://blog.google/technology/ads/new-advertising-brands/ (last accessed July 25, 2024).
Rambachan, Ashesh and Jonathan Roth, "Design-Based Uncertainty for Quasi-Experiments," Working Paper, 2020, available at https://scholar.harvard.edu/sites/scholar.harvard.edu/files/jroth/files/DesignBasedQuasiExperiments.pdf (last accessed July 25, 2024).
"Rémunération des Droits Voisins: l'Autorité Sanctionne Google à Hauteur de 500 Millions d'Euros Pour le Non-Respect de Plusieurs Injonctions," *Autorité de la Concurrence*, July 13, 2021, available at https://www.autoritedelaconcurrence.fr/fr/communiques-de-presse/remuneration-des-droits-voisins-lautorite-sanctionne-google-hauteur-de-500 (last accessed July 25, 2024).
Yang, Heekyong,"S.Korea Fines Google $177 mln for Blocking Android Customisation," *Reuters*, September 14, 2021, available at https://www.reuters.com/technology/skorean-antitrust-agency-fines-google-177-mln-abusing-market-dominance-2021-09-14/ (last accessed July 25, 2024).
Choi, Soo-Hyang and Joyce Lee, "S.Korea Fines Google, Meta Billions of Won for Privacy Violations," *Reuters*, September 15, 2022, https://www.reuters.com/technology/skorea-fines-google-meta-over-accusations-privacy-

law-violations-yonhap-2022-09-14/ (last accessed July 25, 2024).
Schiff, Allison, "Dominance and Collusion: Inside the Unredacted Antitrust Lawsuit Against Google's Ad Tech Business," *AdExchanger*, October 25, 2021, available at https://www.adexchanger.com/platforms/dominance-and-collusion-inside-the-unredacted-antitrust-lawsuit-against-googles-ad-tech-business/ (last accessed July 25, 2024).
Schiff, Allison, "More Details Revealed On Project Bernanke And Jedi Blue In Newly Unsealed Google Suit," *AdExchanger*, January 14, 2022, available at https://www.adexchanger.com/online-advertising/more-details-revealed-on-project-bernanke-and-jedi-blue-in-newly-unsealed-google-suit/ (last accessed July 25, 2024).
Semret, Nemo, "Introducing Minimum CPM Recommendations on DoubleClick Ad Exchange," *DoubleClick Publisher Blog*, November 1, 2011, available at https://doubleclick-publishers.googleblog.com/2011/11/introducing-minimum-cpm-recommendations.html (last accessed July 25, 2024).
Sharma, Deepak, "The Ultimate Guide to Ad Impressions: Maximizing Your Impact," *AdPushUp*, March 31, 2024, available at https://www.adpushup.com/blog/ad-impressions/ (last accessed July 25, 2024).
"Spain Privacy Watchdog Fines Google for Breaking Data Law," *Reuters*, December 19, 2013, available at https://www.reuters.com/article/us-spain-google-privacy/spain-privacy-watchdog-fines-google-for-breaking-data-law-idUSBRE9BI12Z20131219/ (last accessed July 25, 2024).
Judgement Summary (RCW 4.64.030), *State of Washington v. Google, Inc.*, No. 18-2-14130-3, December 17, 2018, available at https://agportal-s3bucket.s3.amazonaws.com/GoogleJudgment-20181218_0.pdf (last accessed July 25, 2024).
Stempel, Jonathan, "Google to pay $155 Million in Settlements Over Location Tracking," *Reuters*, September 15, 2013, available at https://www.reuters.com/legal/google-pay-155-million-settlements-over-location-tracking-2023-09-15/ (last accessed July 25, 2024).
Tanton, Abbi, "Mastering Campaign Measurement: A Guide for B2B Marketers," *Demand Science*, April 2, 2024, available at https://demandscience.com/resources/blog/ways-to-measure-campaign-success/ (last accessed July 25, 2024).
"The Autorité de la Concurrence Hands Out a €220 Millions Fine to Google for Favouring its Own Services in the Online Advertising Sector," *Autorité de la Concurrence*, June 7, 2021, available at https://www.autoritedelaconcurrence.fr/en/communiques-de-presse/autorite-de-la-concurrence-hands-out-eu220-millions-fine-google-favouring-its (last accessed July 25, 2024).
"The Role of Discount Rates in Cost Benefit Analysis," *Faster Capital*, June 26, 2024, available at https://fastercapital.com/content/The-Role-of-Discount-Rates-in-Cost-Benefit-Analysis.html (last accessed July 25, 2024).
Trevisani, Jonathan, "The Best Ad Exchanges for Publishers in 2024," *Playwire*, available at https://www.playwire.com/blog/best-ad-exchanges-for-publishers (last accessed July 25, 2024).
"Turkey Fines Google $16mn for Violating Competition Rules," *bne IntelliNews*, February 16, 2020, available at https://www.intellinews.com/turkey-fines-google-16mn-for-violating-competition-rules-176710/ (last accessed July 25, 2024).
"Turkey fines Google for Abusing Dominant Position," *Reuters*, April 14, 2021, available at https://www.reuters.com/technology/turkey-fines-google-abusing-dominant-position-2021-04-14 (last accessed July 25, 2024).
Cantekin, Kayahan, "Turkey: Competition Authority Fines Google and Subsidiaries for Abuse of Market Dominance," *Library of Congress*, December 8, 2020, available at https://www.loc.gov/item/global-legal-monitor/2020-12-08/turkey-competition-authority-fines-google-and-subsidiaries-for-abuse-of-market-dominance/ (last accessed July 25, 2024).
Scarcella, Mike, "US court sanctions Google in privacy case, company's second legal setback in days," *Reuters*, March 30, 2023, available at https://www.reuters.com/legal/us-court-sanctions-google-privacy-case-companys-second-legal-setback-days-2023-03-30/ (last accessed July 25, 2024).
"What is Fill Rate? Definition, Types, & Calculations," *AdQuick*, available at https://www.adquick.com/adtech/fill-rate (last accessed July 25, 2024).
"Why Oracle Cloud Infrastructure over Google Cloud Platform," *Oracle*, available at https://www.oracle.com/cloud/oci-vs-google-cloud/ (last accessed July 25, 2024).
Wu, Susan, "How Publishers And Advertisers Can Activate Sell-Side Targeting," *PubMatic*, February 8, 2023, available at https://pubmatic.com/blog/how-publishers-and-advertisers-can-activate-sell-side-targeting/ (last accessed July 25, 2024).

Zaiceva, Alise, "What is an Ad Server? | A Complete Guide for Publishers," *Setupad Blog*, September 1, 2023, available at https://setupad.com/blog/ad-server/ (last accessed July 25, 2024).
Zawadziński, Maciej and Mike Sweeney, "How Does Real-Time Bidding (RTB) Work?," *Clearcode*, April 16, 2024, available at https://clearcode.cc/blog/real-time-bidding/ (last accessed July 25, 2024).
Zawadziński, Maciej and Mike Sweeney, "What is an Ad Server and How Does It Work?," *Clearcode*, March 7, 2018, available at https://clearcode.cc/blog/what-is-an-ad-server/ (last accessed July 25, 2024).

Appendix C: Further Analyses of Transaction Counts

[redacted]

[redacted]

[redacted]

[redacted]

Appendix D: Estimates of Increase to Google's Profit from the Alleged Deception

284. In Section VII, I conclude that the alleged deception related to RPO, DRS v1, DRS v2, and Bernanke was unlikely to have impacted auction outcomes because advertisers and publishers likely would not have responded any differently in a "but-for world" (free from the alleged deception) than they did in the actual world (where they already learn and experiment regularly). In this Appendix, however, I provide estimates of the impact that the alleged deception about each of these programs could have had on Google's profit if one were to adopt plaintiffs' incorrect assertion that the alleged deception prevented advertisers and publishers from learning and adjusting their strategies. I focus specifically on the impact of the alleged *deception* about each program, separate from the impact of the *program itself*. In short, I isolate the effect of the alleged deception about each program on Google's profit.

285. In my analyses below, I begin by evaluating plaintiffs' experts' description of how the alleged deception about each program impacted advertiser bidding behavior. I then quantify the extent to which such changes in advertiser bidding behavior could have generated increased profits for Google, if plaintiffs' experts' theory was accurate. I also analyze plaintiffs' experts' assertions regarding how publisher behavior would have been different, absent the alleged deception, and any likely impacts to Google's profit.

286. Mr. Andrien asserts that "Google directly benefits from its misconduct every time an auction clears on AdX that would not have cleared but-for the misconduct, or if the clearing price was higher than it would have been absent the misconduct."[522] As explained in Section III.B., I interpret this statement to posit what economists generally refer to as "quantity effects" and "price effects."

1. Advertiser Responses That Could Have Generated Incremental Google Profit Through Price Effects If Plaintiffs' Theory Was Correct

287. Plaintiffs' experts argue that the alleged deception about RPO, DRS v1, and Bernanke led

[522] Andrien Report at ¶ 110. In the same paragraph, Mr. Andrien goes on to explain, "For example, each time an auction cleared in AdX because Google used DRS to adjust its take rate, Google directly benefited because it earned a fee that it would not have earned without employing DRS. Similarly, each time the clearing price of an auction was higher than it would have been but for Google's use of RPO, Google directly benefited because its fees are set as a percentage of the auction price. Therefore, the higher the clearing price, the higher Google's fee." *Id.*

to higher clearing prices on AdX auctions because that alleged deception prevented advertisers from shading (i.e., lowering) their bids, which (all else equal) would have led to lower auction clearing prices in the but-for world. Under plaintiffs' theory, reduction in clearing prices in the but-for world implies that Google generated more revenue and profit in the actual world than it would have generated in the but-for world.[523] Separately for RPO, DRS v1, and Bernanke, I quantify such incremental profits using the nine-step methodology described below.

288. Step 1: I begin with the number of Open Auction transactions[524] on AdX won by DV360 or Authorized Buyers that (i) are associated with U.S. users, (ii) occurred between the time when the program in question was launched and when it was disclosed, and (iii) can be allocated to plaintiff States using Mr. Andrien's methodology.[525] Next, I compute the percentage of those transactions in which the clearing price was set by a bidder who, according to plaintiffs' experts' theory, would have shaded its bids in the but-for world.[526] I then multiply the number of transactions by the percentage of transactions in which the clearing price was set by a bidder who would have shaded. I refer to the resulting figure as the "baseline transaction count for DV360/Authorized Buyers."

289. Step 2: I repeat the calculations described in Step 1 for auctions won by Google Ads. I refer to the resulting figure as the "baseline transaction count for Google Ads."

290. Step 3: I sum the baseline transaction count for DV360/Authorized Buyers (Step 1) and the baseline transaction count for Google Ads (Step 2) to arrive at the total number of transactions in which the clearing price is set by bidders who would have shaded their bids in the but-for world, according to plaintiffs' theory. I refer to the resulting figure as the "baseline total transaction count."

291. Step 4: I calculate the average clearing price of those transactions included in the baseline total transaction count (Step 3).

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[523] Andrien Report at ¶ 110.

[524] Following Mr. Andrien, I count transactions on the basis of matched queries. See Andrien Report at ¶ 97.

[525] See Andrien Report Exhibit 1, which shows that Mr. Andrien allocated approximately 29% of transactions to plaintiff States.

[526] The set of bidders who would have shaded their bid in the but-for world, under plaintiffs' theory, varies by the alleged deceptive program. For RPO and DRS v1, only DV360 and Authorized Buyers bidders would be incentivized to shade bids because Google Ads was exempt from those programs. For Bernanke, only Google Ads bidders would be incentivized to shade bids because only Google Ads was subject to Bernanke.

292. Step 5: I calculate a "shading factor" to scale how much higher average clearing prices are in the actual world, as compared to the but-for world posited by plaintiffs. This calculation involves the multiplication of two inputs.

293. The first input into the shading factor assumes that, in plaintiffs' but-for world, advertisers would shade their bids by [redacted] in auctions where they know they will pay their bid in every auction. [redacted] This assumption likely overstates the amount of shading that would be optimal because advertisers likely would shade less when bidding into a larger exchange such as AdX.[529] Accordingly, this assumed level of shading likely leads me to overestimate Google's profit from the alleged deception.

294. The second input into the shading factor estimates the percentage of transactions won by a bidder subject to the program at issue in which that bidder paid either the amount of its bid, or in the case of RPO, the RPO floor price.

295. By multiplying these two inputs, I derive a "shading factor." This shading factor is a weighted average of how much advertisers would shade if they knew that they were going to pay their bid on every auction [redacted] and how much they would shade in the absence of

[527] Project Poirot was designed to identify exchanges that were using non-second price auctions, and then reduce advertiser bids into those exchanges to maximize expected advertiser surplus (i.e., the difference between how much advertisers value impressions and how much they pay for them). See, e.g., GOOG-DOJ-11247631 at -631 ("We always knew that some exchanges deviate from second price auctions. This project uses an algorithmic framework to detect deviations from second price auctions and adjust advertiser's fixed CPM bids ***with the goal to win the same impression at a lower price***.") (emphasis in original)); see also 30(b)(6) [redacted] (Google) Deposition at 245:19-246:5 ("Project Poirot itself applied to every exchange; but, of course, a non-second-price auction exchange is where we expect the optimal bid to differ from the fixed CPM number.… What Project Poirot is really doing is it's maximizing -- it's trying to come up with the optimal bid to the exchange to maximize advertiser surplus.").

[528] See GOOG-DOJ-05283173 at -179.

[529] It is well-known in auction theory that an increase in the number bidders in a first price auction reduces the optimal amount of shading. The intuition for this result is that with a larger number of bidders, there is a higher probability that a rival bidder will have a high value for the impression and thus submit a high bid, creating an imperative that each bidder submit a higher bid that is closer to its value (i.e., shade less) to increase its chance of winning. The logic is the same as when firms set lower prices when facing more competition. See Easley, David and Jon Kleinberg, "Chapter 9: Auctions," *Networks, Crowds, and Markets: Reasoning about a Highly Connected World*, Cambridge University Press, 2010, pp. 249-273 at 257, available at https://www.cs.cornell.edu/home/kleinber/networks-book/networks-book-ch09.pdf (last accessed July 25, 2024) ("[I]t is intuitively natural that your bid should be higher – i.e. shaded less, closer to your true value – in a first price auction with many competing bidders than in a first-price auction with only a few competing bidders (keeping other properties of the bidders the same."); *id.* at 263 ("The form of this strategy highlights an important principle … about strategic bidding in first-price auctions: as the number of bidders increases, you generally have to bid more 'aggressively,' shading your bid down less, in order to win.").

the program in question (0%), where the weight is the frequency with which the winning bidder pays its own bid or, in the case of RPO, the RPO floor price.

296. Step 6: I estimate the per-transaction increase in clearing price due to the alleged deception about the program by multiplying the average clearing price (Step 4) by the shading factor (Step 5).[530]

297. Step 7: I estimate Google's total additional gross revenue from the alleged deception about the program by multiplying the baseline total transaction count (Step 3) by the per-transaction change in clearing prices (Step 6).

298. Step 8: I calculate the average Google revenue share on the transactions included in the baseline total transaction count (Step 3) as a weighted average of the Google revenue shares on transactions won by Google Ads, DV360, and Authorized Buyers.[531]

299. Step 9: I calculate Google's additional net revenue from the alleged deception (under plaintiffs' theory) by multiplying the total additional gross revenue to Google (Step 7) by the average Google revenue share (Step 8). I assume that the affected transactions would have occurred with or without the bid shading, which implies that Google's costs would be the same in the actual and but-for worlds. As a result, Google's additional net revenue from the alleged deception equals its incremental profits from the alleged deception.

300. In addition to claiming that the alleged deception prevented advertiser bid shading, plaintiffs' experts theorize that the alleged deception about RPO, DRS v1, and Bernanke prevented publishers from optimizing their price floors.[532] I do not attempt to quantify the

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[530] I assume that shading does not change the rank order of bids, so it does not change the identity of the bidder that sets the clearing price.

[531] For transactions won by Authorized Buyers, the relevant revenue share is AdX's revenue share; for transactions won by Google Ads, the relevant revenue share is the cumulative revenue share of AdX and Google Ads; and for transactions won by DV360, the relevant revenue share is the cumulative revenue share of AdX and DV360.

[532] For example, for RPO, see Andrien Report at ¶ 33 ("I further understand that RPO impacted both publishers and advertisers because it led to lower payoff to advertisers and it could prevent publishers from effectively optimizing revenue, and that such negative impacts partially stem from Google's concealment of RPO."); *id.* at ¶ 34 ("In addition, I understand that both before and after RPO was announced as optimized pricing, RPO impacted publisher behavior. For example, by concealing RPO, Google prevented publishers from effectively optimizing revenue, and even after it was disclosed, publishers might set suboptimal reserves on any impression for which RPO may have been active.").

For DRS v1, see Weinberg Report at ¶ 219 ("Google concealed material information from publishers by not disclosing the implementation of DRSv1. Since publishers believed that AdX runs a regular second-price with their given reserve price and a static take rate of 20%, a strategic publisher would set a price floor that maximized their revenue under these circumstances. Had they known AdX dynamically adjusted its take rate, publishers would set

effect of the hypothesized changes in publisher price floors for several reasons.

301. First, none of plaintiffs' experts have provided evidence, or even asserted, that the hypothesized changes in price floors imply that Google profited as a result of the deception.

302. Second, the effect of changes in price floors on Google's profits is theoretically ambiguous. Consider, for example, a case in which publishers increased the price floor in the but-for world:

a. For transactions that clear on AdX even with the higher floor, the higher floor would increase the clearing price and thus raise Google's profit.

b. For transactions that do not clear on AdX due to the higher floor, (but would have cleared with the lower floor), the higher floor would reduce Google's profit.

c. Because the two effects have opposite implications for Google's profit, the net effect is theoretically ambiguous.

303. Third, economic analysis suggests that a publisher would only change its price floors if doing so resulted in increasing its own revenues from AdX.[533] The reason is that, as a general matter, firms make decisions based on whether the incremental benefits from a decision exceeds its incremental costs.[534] As a result, if a publisher in the but-for world were to set different reserve prices than in the actual world, economic reasoning predicts

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different price floors."); see also *id.* at ¶ 219 footnote 333 ("That is, one natural publisher response to DRSv1 is to increase price floors on AdX.").

For Bernanke, see Weinberg Report at Section VIII.C.3 Title ("publishers would have raised their reserve prices to maximize their revenue had they known about Projects Bernanke and Global Bernanke.").

[533] This assumes that a publisher's opportunity cost of selling the impression on AdX—as opposed to other available demand sources—is not affected by the alleged deception, which I believe is a reasonable assumption. Furthermore, some publisher reserve prices tend to overstate the publisher opportunity cost of the impression, which makes it less likely that publishers would find it optimal to lose AdX transactions. See August 4, 2023 [redacted] Declaration at ¶ 11 ("Some publishers set Value CPMs based on their estimates of what CPM a line item would likely generate (taking into account its historical performance) or based on a fixed price the publisher had negotiated with a particular remnant demand partner. Some publishers set Value CPMs higher than their estimates of what CPM a line item would likely generate to increase competitive pressure in the AdX auction or for other reasons."); see also GOOG-DOJ-03998505 at -506 ("We've anecdotally heard from some publishers that they inflate the value CPM of remnant line items to try and extract more value from AdX."); [redacted] (Google), "Re: Unified Auction Changes (Sellside) Executive Update – Aug 12, 2019," August 19, 2019, GOOG-DOJ-07960537 at -538 (reporting that "many publishers … apply a boost to Header Bidding bids" and that "these inflated CPMs are used to provide price pressure for AdX, which can result in increased publisher revenue.").

[534] See, e.g., Mankiw, N. Gregory, *Principles of Microeconomics*, Cengage Learning, 5th ed. 2008, at 294.

that change would occur because the publisher generates higher revenue from the higher price floor, which also leads to higher net revenue for AdX and higher profits for Google in the but-for world because AdX revenue is based on a revenue-sharing model with publishers.[535] Thus, under plaintiffs' theory, if publishers were to change their price floors in the but-for world, then Google's profits would be *lower* in the actual world than the but-for world. As a result, disregarding the effect of the alleged deception on publisher floors is conservative for purposes of this analysis.

a. Reserve Price Optimization

304. Plaintiffs' experts theorize that, if advertisers had understood that RPO used information gleaned from their historical bids to set price floors closer to their true values, then they would have shaded their bids because, by bidding less for impressions, advertisers would induce Google to set lower future RPO floor prices.[536] This theory implies that the alleged deception about RPO caused clearing prices for some auctions to be higher than they would have been in the but-for world, leading to increased Google profits from this "price effect."

305. I calculated the incremental Google profit from the alleged deception about RPO using the nine-step methodology described above for estimating how, according to plaintiffs' theory, the alleged deception prevented advertisers from responding optimally to their environment by shading their bids. Each of the steps is described below and summarized in the second-to-last column of Table D1.

306. In Step 1, I begin by determining from Google data that there were [redacted]

[535] Professor Weinberg acknowledges in his report, "if Google is good at optimizing reserves via RPO, a publisher may wish to lower the reserve it sets on AdX in order to give AdX greater flexibility in optimizing its reserve, which would lead to greater revenues for both AdX and the publisher." Weinberg Report at ¶ 279. Dr. Pathak also suggests that, had they known about RPO, "publishers would change their reserve prices. Reserve prices are an important tool of revenue maximization for publishers. If they knew Google was going to adjust their reserve prices, they would take that information into consideration when they are calculating their optimal reserve prices." Pathak Report at ¶ 191. Dr. Pathak, however, does not explain how he believes publishers would have changed floors.

[536] See, e.g., Weinberg Report at ¶¶ 283-285 ("[With RPO] submitting a high bid equal to an advertiser's true value would cause later AdX reserves to increase, decreasing that advertiser's future payoff in later AdX auctions.… If the advertiser were aware of RPO, they would have shaded their bid from the beginning."); Pathak Report at ¶ 191 ("Since RPO increased reserve prices dynamically based on past data, the advertisers' bidding patterns now can influence the reserve prices they face in the future. As a result, even though AdX ran a second-price auction at the time, had they known, the advertisers might have wanted to shade their bids, to increase their future payoff by decreasing future reserve prices.").

transactions won by DV360 or Authorized Buyers that occurred between when RPO launched (April 2015[537]) and when it was disclosed (May 2016[538]), and that can be allocated to plaintiff States using Mr. Andrien's method.[539] Next, an internal Google document indicates that DV360 or Authorized Buyers set the clearing price in [redacted] of those auctions.[540] Multiplying those figures, I calculate that the baseline transaction count for DV360/Authorized Buyers is [redacted].

307. In Step 2, I use an analogous method to determine that the baseline transaction count for Google Ads is [redacted].[541]

308. In Step 3, I sum the results from Steps 1 and 2 to arrive at a baseline total transaction count of [redacted].

309. In Step 4, I calculate an average clearing price of [redacted].

310. In Step 5, I estimate a shading factor of [redacted] by multiplying the assumed amount that advertisers would shade their bids when they *always* pay their bid ([redacted][542]) by the

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[537] [redacted], Google launched Reserve Price Optimization ("RPO") in April 2015. See Defendant Google LLC's First Amended Responses and Objections to Plaintiffs' Third Set of Interrogatories, May 24, 2024, at 12 ("Reserve Price Optimization launched on or about March 31, 2015. RPO v2 subsequently launched on or about October 5, 2015. Prior versions of RPO were disabled along with the Google Ad Manager switch to first-price auctions in September 2019. In June 2022, Google launched a version of RPO designed for Ad Manager's first-price auction, known as Optimized Pricing, on select web traffic, and it was extended to all web traffic in January 2023." (emphasis omitted)).

[538] See Bellack, Jonathan, "Smarter optimizations to support a healthier programmatic market," *Google Ad Manager Blog*, May 12, 2016,

available at https://blog.google/products/admanager/smarter-optimizations-to-suppor/ (last accessed July 26, 2024) (explaining that RPO [called Optimized pricing in the announcement] "uses historical data to automate the post-auction analysis and updating of floor prices."); see also GOOG-AT-MDL-C-000015606 at -611.

[539] Following Mr. Andrien, when "[the beginning of the penalty period] is after the first day of the month, violation count starts on the first day of the following month; if [the end of the penalty period] is after the first day of the month, violation count ends on the last day of the previous month." Andrien Report Exhibit 4. In this case, this translates in including revenue from April 2015 to April 2016 in the RPO analysis.

[540] See GOOG-DOJ-15719056 at -56. [redacted]

[541] I include transactions won by Google Ads because even though RPO did not apply to Google Ads, the clearing price was sometimes set by DV360 and Authorized Buyers, to whom RPO did apply and who, under plaintiffs' theory, would have shaded their bids in the but-for world.

[542] See GOOG-DOJ-05283173 at -179. While shading in first-price auctions leads directly to a reduction in the clearing price in the same auction where the shading occurs, the logic underlying the incentive to shade when AdX uses RPO to set floors is instead based on how shading in a given auction impacts the floor that AdX sets in *future* auctions. Despite this distinction, I adopt Professor Weinberg's approach and assume for purposes of my calculations that the amount of shading is the same. See Weinberg Report at ¶ 275 (arguing that RPO "aims to set the reserve

percentage of AdX auctions where DV360 and Authorized Buyers[543] won the auction and paid the RPO reserve price. Google documents show that, when DV360 and Authorized Buyers won auctions while RPO was in operation, RPO set the clearing price about [redacted] of the time.[544] A bidder who expects to pay the amount that it bids [redacted] of the time should shade [redacted] as much as it would shade if it paid the amount that it bid 100% of the time. Accordingly, I estimate that, according to plaintiffs' theory, DV360 and Authorized Buyers would shade their bids by [redacted] in the but-for world absent the alleged deception about RPO.

311. In Step 6, I multiply the results from Steps 4 and 5 to estimate that, according to plaintiffs' theory, clearing prices would have been [redacted] lower in the but-for world absent the deception about RPO.

312. In Step 7, I multiply the per transaction reduction in clearing price (Step 6) by the baseline total transaction count (Step 3) to determine that, according to plaintiffs' theory, foregone shading resulted in additional gross revenue to Google of [redacted].

313. In Step 8, I calculate the average Google revenue share on those transactions included in the baseline total transaction count (Step 3) to be [redacted].

314. In Step 9, I multiply the increase in Google's gross revenue (Step 7) by the average Google revenue share (Step 8) to calculate that, according to plaintiffs' theory, the alleged deception about RPO increased Google's net revenue by $6,954,078.

315. Because the transactions considered in these calculations occur in both the actual and but-for worlds, there is no incremental cost associated with them, so according to plaintiffs' theory, Google would have earned $6,954,078 in additional profit due to the alleged deception about RPO.[545]

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price just below what the highest bidder is willing to pay" and that "if AdX has sufficient data to form an accurate prediction of the maximum advertiser value v, the optimal reserve price to set is exactly v").

[543] RPO did not apply to Google Ads. See GOOG-DOJ-13212948. As a result, RPO did not create an incentive for Google Ads to shade.

[544] I conservatively adopt the highest estimate from available documents. [redacted]

[545] Calculations are contained in folder "DTPA_Incremental_Revenue" of my backup.

[redacted]

[redacted]

316. As noted above, this estimate is based on transaction counts from U.S. Open Auctions and allocated to plaintiff States using Mr. Andrien's method. I also calculated how much plaintiffs' theory would predict Google's profits would increase if transaction counts excluded in-app impressions, excluded states that limit recovery to business-to-business transactions, were allocated to the plaintiff States based on advertiser locations, and accounted for statutes of limitations. In that case, as shown in the last column of Table D1, the baseline total transaction count would be [redacted], and the increase in Google's profits would be $2,049,015.

317. Table D5 summarizes the increase in Google's profits from the alleged deception about RPO and other programs (according to plaintiffs' theory) under a range of alternative assumptions about the baseline total transaction count.

318. All of these estimates are conservative because Step 5 likely overstates the incentive to shade, causing me to overstate the gains to Google from the alleged deception. One reason is that any benefit from shading because of RPO comes from an impact on future price floors, rather than direct returns from the current auction. Because firms discount future benefits and costs, the impact of paying a higher price in the future is smaller than the impact of paying a higher price today.[546] A second reason is that even when RPO affects a

[546] See, e.g., "Discounting for Public Policy: Theory and Recent Evidence on the Merits of Updating the Discount Rate," *Council of Economic Advisers Issue Brief*, January 2017, available at https://obamawhitehouse.archives.gov/sites/default/files/page/files/201701_cea_discounting_issue_brief.pdf (last accessed July 25, 2024); see also "The Role of Discount Rates in Cost Benefit Analysis," *Faster Capital*, June 26, 2024, available at https://fastercapital.com/content/The-Role-of-Discount-Rates-in-Cost-Benefit-Analysis.html (last accessed July 25, 2024) ("In the realm of cost-benefit analysis, one crucial factor that plays a significant role is the discount rate.… Put simply, a discount rate is a percentage used to convert future costs and benefits into their present value equivalents. It reflects the time value of money, acknowledging that a dollar received today is worth more than the same dollar received in the future. By discounting future cash flows, analysts can compare and evaluate costs and benefits that occur at different points in time, ensuring a fair and consistent assessment.").

transaction, the clearing price is less than the winning bid.[547] That fact implies that my estimate of how often advertisers are charged their bid is overstated, which in turn implies that my estimate of shading is overstated. Together these facts mean that advertisers would have less incentive to shade bids than what my methodology implies. And if advertisers shade less than I have assumed, the alleged deception about RPO would generate even lower profits for Google.

b. DRS v1

319. Plaintiffs' experts theorize that, if advertisers had known about DRS v1, then they would have shaded their bids.[548] In particular, Professor Weinberg theorizes that "when the highest bid is the unique bid above the hard reserve r and below the soft reserve r/0.8, [advertisers] pay their bid,"[549] creating an incentive to shade. This theory implies that the alleged deception regarding DRS v1 caused clearing prices for some auctions to be higher than they would have been in the but-for world, leading to increased Google profits from this "price effect".

320. I calculated the incremental Google profit from the alleged deception about DRS v1 using the nine-step methodology described above. Each of the steps is described below and summarized in the second-to-last column of Table D2.

321. In Step 1, I begin by determining from Google data that there were [redacted] transactions won by DV360 and Authorized Buyers that occurred when DRS v1 was in effect (between August 2015 and November 2016[550]), and that were allocated to plaintiff

547 [redacted]

548 See Weinberg Report at ¶ 227 ("[C]oncealing DRSv1 caused advertisers to bid their true value in a non-truthful auction, whereas advertisers would get higher a higher gain by shading their bids."); *id.* at ¶ 228 ("By not revealing DRSv1 to the advertisers, Google made material gains. This is because if advertisers were to shade their bids, which is the natural bidding behavior in a non-truthful auction like DRSv1, this would lead to less revenue for both AdX and publishers. However, advertisers likely did not shade their bids, since Google never publicly revealed DRSv1."); see also Pathak Report at ¶ 188 ("Google never disclosed this conduct [DRS v1] to advertisers or publishers who sell or buy impressions through AdX. This is partially because, in the auctions where AdX decreases its take rate, the advertisers are charged their bid, akin to a first-price auction. If the advertisers knew this was a possibility, they would shade their bids in such a situation. This would suppress the bids, reducing AdX revenue, since AdX takes a percentage of the clearing price as its fee. As a result, Google chose to not reveal DRSv1 to its customers, enabling AdX to increase its win rate without facing the repercussions of shaded bids.").

549 Weinberg Report at ¶ 195.

550 I follow Mr. Andrien's approach with respect to the penalties period for DRS v1. See Andrien Report Exhibit 7.

States using Mr. Andrien's method. Next, an internal Google document indicates that DV360 bidders or Authorized Buyers set the clearing price in [redacted] of auctions.[551] I then calculate that the baseline transaction count for DV360/Authorized Buyers is [redacted].

322. In Step 2, I use an analogous method to determine that the baseline transaction count for Google Ads is [redacted].

323. In Step 3, I sum the results from Steps 1 and 2 to arrive at a baseline total transaction count of [redacted].

324. In Step 4, I calculate an average clearing price of [redacted].

325. In Step 5, I estimate a shading factor of [redacted] by multiplying the assumed amount that advertisers would shade their bids when they *always* pay their bid ([redacted][552]) by the percentage of AdX auctions where Authorized Buyers and DV360 paid their bids.[553] An internal Google document indicates that DRS v1 charged Authorized Buyers and DV360 winning advertisers their bids in queries representing [redacted] of revenue.[554] A bidder who expects to pay the amount that it bids [redacted] of the time should shade [redacted] as much as if it paid the amount that it bid 100% of the time. Accordingly, I estimate that, according to plaintiffs' theory, DV360 and Authorized Buyers would shade their bids by [redacted] in a but-for world absent the alleged deception about DRS v1.

326. In Step 6, I multiply the results from Steps 4 and 5 to estimate that, according to plaintiffs' theory, clearing prices would have been [redacted] lower in the but-for world absent the alleged deception about DRS v1.

327. In Step 7, I multiply the per-transaction reduction in gross clearing price (Step 6) by the transaction count (Step 3) to determine that, according to plaintiffs' theory, foregone

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[551] See GOOG-DOJ-15719056 at -056. [redacted] t.

[552] See GOOG-DOJ-05283173 at -179.

[553] Google Ads was exempt from DRS v1. GOOG-DOJ-15068390 at -391 ("This launch applies to AdX buyers (incl. DBM) on AdX sellers: … AdWords (GDN): N[o]").

[554] See GOOG-AT-MDL-007375273 at -273. At the time, DRSv1 applied to both Authorized Buyers and DV360 and I interpret the reference to "RTB buyers" in this particular document to include both Authorized Buyers and DV360. The document shows that [redacted] of revenue was associated with bids in the dynamic region (bids where the buyer paid the amount of its bid). Professor Weinberg agrees that, when the bid was in the dynamic region, advertisers paid their bid. See Weinberg Report at ¶ 195 ("[W]hen the highest bid is the unique bid above the hard reserve r and below the soft reserve r/0.8, they win and pay their bid.").

shading resulted in additional gross revenue to Google of [redacted].

328. In Step 8, I calculate the average Google revenue share on those transactions included in the baseline total transaction count (Step 3) to be [redacted].

329. In Step 9, I multiply the increase in Google's gross revenue (Step 7) by the average Google revenue share (Step 8) to calculate that, according to plaintiffs' theory, the alleged deception about DRS v1 increased Google's net revenues by $4,656,540.

330. Because these transactions occur in both the actual and but-for worlds, there is no incremental cost associated with them, so according to plaintiffs' theory Google would have earned $4,656,540 in additional profit due to the alleged deception about DRS v1.[555]

[redacted]

[555] Calculations are contained in folder "DTPA_Incremental_Revenue" of my backup.

[redacted]

331. This estimate is based on transaction counts from U.S. Open Auctions and allocated to plaintiff States using Mr. Andrien's method. I also calculated how much plaintiffs' theory would predict Google's profits would increase if transaction counts excluded in-app impressions, excluded states that limit recovery to business-to-business transactions, were allocated to the plaintiff States based on advertiser locations, and accounted for statutes of limitations. In that case, as shown in the last column of Table D2, the baseline total transaction count would be [redacted], and the increase in Google's profits would be $1,339,893.

332. Plaintiffs' experts also theorize that the alleged deception regarding DRS v1 prevented publishers from optimally adjusting their price floors.[556] I discussed why I do not attempt to measure the impact of such changes in price floors on Google profit in the introduction to Part 1 of this Appendix. In addition to the reasons discussed there, in the case of DRS v1, the available evidence indicates that any such effects on price floors would be

[556] See Weinberg Report at ¶ 219 ("Google concealed material information from publishers by not disclosing the implementation of DRSv1. Since publishers believed that AdX runs a regular second-price with their given reserve price and a static take rate of 20%, a strategic publisher would set a price floor that maximized their revenue under these circumstances. Had they known AdX dynamically adjusted its take rate, publishers would set different price floors.").

small.[557,558]

333. Table D5 summarizes the increase in Google's profits from the alleged deception about DRS v1 and other programs (according to plaintiffs' theory) under a range of alternative assumptions about the baseline total transaction count.

c. Project Bernanke

334. Similar to RPO and DRS v1, plaintiffs' experts theorize that if advertisers had known about Bernanke, then they would have reduced their bids—or more accurately, their MaxCPC, which forms the basis of the bids that Google Ads placed in the AdX auction on their behalf.[559,560] According to plaintiffs' theory, Bernanke makes it optimal for advertisers to reduce their MaxCPC because Bernanke sometimes results in advertisers paying their bid.[561] This theory implies that the alleged deception about Bernanke caused

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557 [redacted] For example, Professor Weinberg argues that "if the publisher knew that the take-rate could go down to 19% on average," the publisher could respond by increasing the floor price. In particular, if *r* is the optimal publisher floor without DRS and r' is the optimal publisher floor with DRS v1, then the publisher could set the floor with DRS v1 such that: r'/81%=r/80%. See Weinberg Report at ¶ 219, footnote 333. This means that, in a but-for world where publishers responded to a disclosure of DRS v1, price floors would be only 1.25% (81%/80% - 1) higher than in the actual world.

558 I also note that DRS v1 was mainly used to overcome publisher-set floors that were too high (rather than floors determined by header bidding, which would generally compete with AdX through the DA/EDA floor). As a result, it is unlikely that publishers would find it optimal to increase floors. See GOOG-AT-MDL-007375273 at -273 [redacted] See *ibid*. [redacted] See *ibid*.; see also August 4, 2023 [redacted] Declaration at ¶ 32 ("In most cases when DRS applied, the reserve price was set by the publisher-set floor price.").

559 See Weinberg Report at ¶¶ 258-261 ("Advertisers would have shaded their bids to maximize their payoff had they known about Projects Bernanke and Global Bernanke … Provided that neither Project Bernanke nor Project Global Bernanke were disclosed to advertisers, they would naturally believe they were still participating in a truthful second-price auction and bid their true value as a result. If advertisers knew they were participating in a non-truthful auction, they would have instead considered shading their bids."); see also Pathak Report at ¶ 183 ("If Google Ads announced [Bernanke] to the public … advertisers would shade their bids.").

560 As I explain in Section II.A, it is incorrect to think of Google Ads advertisers as submitting "bids." When advertisers pay on a CPC or CPA basis, as most Google Ads advertisers do, the advertiser sets up budgets, constraints, and objectives, commonly including a maximum cost-per-click (CPC) or maximum cost-per-action (CPA) that it is willing to pay; but the advertiser does not bid in an auction nor specify CPM-based bid amounts (which compete on a CPM basis).

561 GOOG-DOJ-AT-02467209 at -209.

clearing prices for some auctions to be higher than they would have been in the but-for world, leading to increased Google profits from this "price effect."

335. I calculated the incremental Google profit from the alleged deception about Bernanke using the same nine-step methodology described above. Each of the steps is described below and summarized in the second-to-last column of Table D3.

336. In Step 1,[562] I begin by determining from Google data that there were [redacted] transactions won by DV360 bidders and Authorized Buyers during the period between November 2013 and October 2019 and that were allocated to plaintiff States using Mr. Andrien's method. Next, I calculate that Google Ads bidders set the clearing price in [redacted] of these transactions.[563] Multiplying those figures, I calculate that the baseline transaction count for DV360/Authorized Buyers is [redacted].

337. In Step 2, I use an analogous method to determine that the baseline transaction count for Google Ads is [redacted].

338. In Step 3, I sum the results from Steps 1 and 2 to arrive at a baseline total transaction

[562] For both Steps 1 and 2 it is important to note that, before AdX adopted a first-price format there were two different versions of Bernanke that have a material impact on transaction counts. The first version of Bernanke, which was introduced in November 2013, applied to all Google Ads advertisers. As a result, from November 2013 to March 2016, I include all transactions in which a Google Ads advertiser set the clearing price. However, beginning in April 2016 and continuing through September 2019, this first version of Bernanke applied only to a relatively small number of advertisers who were not using some form of automated bidding tool. See GOOG-DOJ-AT-02467209 "Do not first-price conversion optimizer ads on [redacted] and AdX. Instead charge the minimum price needed to win the query. No change for non-CO ads.…We propose that for CO [Conversion Optimizer] advertisers (tCPA, fixed CPA, ROAS) gTrade should charge the minimum price to win the query, which makes the traffic look like regular second price auction."). Advertisers who were using automated bidding tools operated under a second form of Project Bernanke that did *not* give them an incentive to lower their bids (i.e., it was "truthful"). See GOOG-DOJ-AT-02467209. Accordingly, even if this form of Bernanke had been disclosed, advertisers who were using automated bidding tools would not have had an incentive to bid less than they did in the actual world, so during the period between April 2016 and September 2019, I include only auctions in which those few advertisers who were not using automated bidding set the clearing price. The percentage of Google Ads revenue where the advertiser used autobidding is estimated using data produced by Google. See GOOG-AT-DOJ-DATA-000011657 to GOOG-AT-DOJ-DATA-000012656; see also Letter from D. Pearl to W. Noss and Z. DeRose, "Re Data Dictionaries," May 3, 2024. When AdX adopted a first-price auction format in September 2019, Bernanke was replaced by Alchemist, also at times referred to as first-price Bernanke. See Bigler, Jason, "Rolling out first price auctions to Google Ad Manager partners," *Google Ad Manager Blog*, September 5, 2019, available at https://blog.google/products/admanager/rolling-out-first-price-auctions-google-ad-manager-partners/ (last accessed July 25, 2024). Alchemist is also truthful, so Google Ads advertisers did not have an incentive to shade their bids after it went into effect. As a result, I do not include any transactions after September 2019.

[563] [redacted].

count of [redacted].

339. In Step 4, I calculate an average clearing price of [redacted].

340. In Step 5, I estimate a shading factor of [redacted] by multiplying the assumed amount that advertisers would shade their bids when they *always* pay their bid ([redacted][564]) by the percentage of AdX auctions where Google Ads advertisers[565] paid their bids. An internal Google document indicates that Bernanke charged Google Ads bidders their bid on [redacted] of queries.[566] A bidder who expects to pay the amount that it bids [redacted] of the time should shade [redacted] as much as if it paid the amount it bid 100% of the time. Accordingly, I estimate that, according to plaintiffs' theory, Google Ads bidders would shade their bids by [redacted] in a but-for world absent the alleged deception about Bernanke.

341. In Step 6, I multiply the results from Steps 4 and 5 to estimate that, according to plaintiffs' theory, clearing prices would have been [redacted] lower in the but-for world absent the alleged deception about Bernanke.

342. In Step 7, I multiply the per transaction reduction in clearing price (Step 6) by the baseline total transaction count (Step 3) to determine that, according to plaintiffs' theory, foregone shading resulted in additional gross revenue to Google of [redacted].

343. In Step 8, I calculate the average Google revenue share on those transactions included in the baseline total transaction count (Step 3) to be [redacted].

344. In Step 9, I multiply the increase in Google's gross revenue (Step 7) by the average Google revenue share (Step 8) to calculate that, according to plaintiffs' theory, the alleged deception about Bernanke increased Google's net revenue by $24,829,034.

345. Because the transactions considered in these calculations occur in both the actual and but-for worlds, there is no incremental cost associated with them, so according to plaintiffs' theory, Google would have earned $24,829,034 in additional profit due to the alleged deception about Bernanke.[567]

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[564] See GOOG-DOJ-05283173 at -179.

[565] Project Bernanke only applied to Google Ads, and did not apply to DV360 or Authorized Buyers.

[566] GOOG-DOJ-AT-02467209 at -209.

[567] Calculations are contained in folder "DTPA_Incremental_Revenue" of my backup.

[redacted]

[redacted]

346. As noted above, this estimate is based on transaction counts from U.S. Open Auctions and allocated to plaintiff States using Mr. Andrien's method. I also calculated how much plaintiffs' theory would predict Google's profits would increase if transaction counts excluded in-app impressions, excluded states that limit recovery to business-to-business transactions, were allocated to the plaintiff States based on advertiser locations, and accounted for statutes of limitations. In that case, as shown in the last column of Table D3, the baseline total transaction count would be [redacted], and the increase in Google's profits would be $14,359,456.

347. Table D5 summarizes the increase in Google's profits from the alleged deception about Bernanke and other programs (according to plaintiffs' theory) under a range of alternative assumptions about the baseline total transaction count.

2. Advertiser Responses to DRS v2 That Could Have Generated Incremental Google Profit Through Quantity Effects

348. Professor Weinberg theorizes that "[i]f all advertisers responded optimally to DRSv2, no advertiser would bid in the dynamic region, and therefore DRSv2 would be equivalent to no DRS. That is, exactly the same advertisers would win exactly the same impressions and pay exactly the same amount and the entire DRSv2 program would be obviated."[568] In other words, Professor Weinberg theorizes that the transactions that occur in the dynamic region—the region "between the publisher-set reserve of *r* and the effective reserve of

[568] Weinberg Report at ¶ 226; see also Andrien Report at ¶ 110 ("Google directly benefits from its misconduct every time an auction clears on AdX that would not have cleared but-for the misconduct, or if the clearing price was higher than it would have been absent the misconduct. For example, each time an auction cleared in AdX because Google used DRS to adjust its take rate, Google directly benefited because it earned a fee that it would not have earned without employing DRS.").

r/0.8"[569]—reflect incremental transactions due to the alleged deception. This theory implies that the alleged deception about DRS v2 caused more transactions to clear on AdX in the actual world than in the but-for world absent the alleged deception, leading to increased Google profits from a "quantity effect."

349. I calculated the incremental Google profit from the alleged deception about DRS v2 using a seven-step methodology. Each of the steps is described below and summarized in the second-to-last column of Table D4.

350. Step 1: I begin by determining from Google data that there were [redacted] transactions won by Authorized Buyers[570] between when DRS v2 launched (December 2016) and when it was replaced by tDRS (July 2018)[571] that were allocated to plaintiff States using Mr. Andrien's method.

351. Step 2: Based on an internal Google document, I calculate that DRS v2 lowered AdX's revenue share in [redacted] of the transactions won by Authorized Buyers where the winning bid was in the "dynamic region." [572]

352. Step 3: I multiply the number of transactions won by Authorized Buyers (Step 1) by the percentage of those transactions with winning bids in the "dynamic region" (Step 2) to determine that, according to plaintiffs' theory, there were [redacted] incremental

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[569] Weinberg Report at ¶ 206.

[570] I exclude transactions won by Google Ads and DV360 because DRS v2 did not apply to them. See Email from [redacted] (Google), "Fwd: [Monetization-pm] [drx-pm] LAUNCHED! AdX Dynamic Revenue Share (DRS)," September 11, 2015, GOOG-DOJ-15068390 at -291; Email from [redacted] "[Launch 145022] Dynamic Revshare v2 on Ad Exchange for AdX Buyers," March 10, 2016, GOOG-DOJ-14717283 at -283; Email from [redacted] "OVERDUE LAUNCH – Please update: [Launch 169646] Remove DBM from AdX dynamic revshare," November 9, 2016, GOOG-DOJ-14734878 at -878.

[571] See Andrien Report Exhibit 7 at 128. I include transactions occurring over this time period even though Professor Weinberg acknowledged that "Google announced DRSv2 when it was launched" and "the publishers were allowed to opt out of DRSv2." Weinberg Report at ¶ 197. In particular, on June 13, 2016, before it launched DRS v2, Google announced that, "[a]s part of our ongoing efforts to provide smarter optimizations and maximize revenue, *we may increase or decrease revenue share per query*. If you'd prefer to apply your contracted revenue share on every query, use the new Ad Exchange UI Admin control to exclude all the sites you monetize through your account from revenue share-based optimizations." See "2016 releases archive: DoubleClick for Publishers and Ad Exchange Seller," *Google Ad Manager Help*, June 13, 2016, available at https://support.google.com/admanager/answer/7421657?sjid=10086602547051235141-NA#zippy=%2Cjune-change-history-update-safeframe-for-creative-types-deal-check-bid-filter-apply-per-query-revenue-share-optimization (last accessed July 25, 2024) (under the Q2 2016 Ad Exchange release stating "New Ad Exchange control for applying per-query revenue share optimization" (emphasis added)); see also GOOG-AT-MDL-C-000015769 at -779.

[572] See GOOG-AT-MDL-007375273 at -273. [redacted]

transactions generated by the alleged deception about DRS v2.

353. Step 4: I compute the average clearing price for those incremental transactions to be [redacted].[573]

354. Step 5: I estimate the per-transaction gross revenue to Google for these incremental transactions as [redacted]. Professor Weinberg contends that the "effective price" bidders pay on these transactions is the "effective reserve," which he calculates as the reserve price divided by 80% (i.e., the reserve price adjusted to account for AdX's standard 20% revenue share).[574] While I do not have information on the relevant reserve prices, I use the observed clearing price as a proxy for the reserve price and divide by 80% to arrive at my estimate of [redacted] per transaction in gross revenue to Google for incremental transactions.[575]

355. Step 6: I multiply the per-transaction gross revenue (Step 5) by 20%, which is the standard AdX revenue share, to estimate that the net revenue to Google is [redacted] per transaction.

356. Step 7: I multiply the number of incremental transactions (Step 3) by the per-transaction net revenue (Step 6) to determine that, according to plaintiffs' theory, the alleged deception about DRS v2 increased Google's net revenue by $6,981,142.

357. Under the conservative assumption that Google did not incur any incremental costs as a result of the incremental [redacted] transactions, Google would have earned $6,981,142 in additional profit due to the alleged deception about DRS v2.[576]

[573] I calculate clearing price as the ratio of gross revenue and number transactions won by Authorized Buyers.

[574] Weinberg Report at ¶ 206 (explaining that due to DRS v2's "debt mechanism … when an advertiser submits a winning bid in the 'dynamic region' (i.e., a bid between the publisher-set reserve of r and the effective reserve of r/0.8), the advertiser not only pays their bid now resulting in a payoff of 0, but further accumulates debt that must be paid later."). Professor Weinberg shows that the "effective" clearing price "is r/0.8, the effective reserve, which strictly exceeds the winning bidder's bid." *Id*. at ¶ 206(d)(ii). In other words, when AdX wins an auction because of DRS v2, the winning bidder pays its bid, but also accumulates a debt so that, "assuming that all debt is eventually cleared" the effective price is higher than its bid and equals the effective reserve price r/0.8. *Id*. at ¶ 206.

[575] This is likely to be conservative because, in every auction, the clearing price is at least as high as the auction floor (and thus the price I use in my calculations may exceed the floor).

[576] Calculations are contained in folder "DTPA_Incremental_Revenue" of my backup.

[redacted]

358. As noted above, this estimate is based on transaction counts from U.S. Open Auctions and allocated to plaintiff States using Mr. Andrien's method. I also calculated how much plaintiffs' theory would predict Google's profits would increase if transaction counts

excluded in-app impressions, excluded states that limit recovery to business-to-business transactions, were allocated to the plaintiff States based on advertiser locations, and accounted for statutes of limitations.[577] In that case, as shown in the last column of Table D4, the baseline total transaction count would be [redacted], and the increase in Google's profits due to the alleged deception would be $3,975,659.

359. Table D5 summarizes the increase in Google's profits from the alleged deception about DRS v2 and other programs (according to plaintiffs' theory) under a range of alternative assumptions about the baseline total transaction count.

360. Plaintiffs' experts theorize that the alleged deception regarding DRS v2 also misled publishers, though they stop short of describing how publishers would have set floor prices differently in the but-for world.[578] To the extent that plaintiffs believe that publishers would have changed price floors in the but-for world, I discussed why I do not attempt to measure the impact of such changes in price floors in the introduction to Part 1 of this Appendix. In addition to those reasons, in the case of DRS v2, the available evidence indicates that any effects from these publisher responses would be small because, as noted above, publishers (and advertisers) were informed about DRS v2 before it was launched, and publishers were allowed to opt out of DRS v2.[579]

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[577] In applying States' statutes of limitations, I conservatively assume that the deception was revealed in October 2021 with the unsealing of the complaint, which implies that no states are time-barred from recovering penalties. As discussed above in Section IV.E.c, Google publicly announced on its Google Ad Manager Help website in June 2016 that "we may increase or decrease revenue share per query", which is the key mechanist behind DRS v2. "2016 releases archive: DoubleClick for Publishers and Ad Exchange Seller," *Google Ad Manager Help*, June 13, 2016, available at https://support.google.com/admanager/answer/7421657?sjid=10086602547051235141-NA#zippy=%2Cjune-change-history-update-safeframe-for-creative-types-deal-check-bid-filter-apply-per-query-revenue-share-optimization. (last accessed July 25, 2024) (under the Q2 2016 Ad Exchange release stating "New Ad Exchange control for applying per-query revenue share optimization"). Therefore, the deception ended even before DRS v2 started, in which case there would be not incremental revenue related to the deception.

[578] See Andrien Report at ¶ 42 ("The same is true of DRSv2. I understand that some aspects of DRSv2 were misleading to advertisers and publishers based, in part, on Google's omissions in clearing disclosing the concept of debt with DRSv2, which mislead both advertisers and publishers regarding how much they are paying or paid out, prevented them from employing optimal bidding strategies, and obscured feedback to advertisers."); Weinberg Report at ¶ 231(b) ("For DRSv2, Google states: 'sellers are always paid at least their reserve.' I find this claim misleading to publishers.").

[579] Professor Weinberg acknowledges that "Google announced DRSv2 when it was launched" and "the publishers were allowed to opt out of DRSv2." Weinberg Report at ¶ 197. In particular, on June 13, 2016, before it launched DRS v2, Google announced that, "[a]s part of our ongoing efforts to provide smarter optimizations and maximize revenue, *we may increase or decrease revenue share per query*. If you'd prefer to apply your contracted revenue share on every query, use the new Ad Exchange UI Admin control to exclude all the sites you monetize through your account from revenue share-based optimizations." "2016 releases archive: DoubleClick for Publishers and Ad

3. Summary of Incremental Google Profit Due to the Alleged Deception

361. The final row in Table D5 below summarizes the results discussed in this Appendix, and other rows summarize results based on alternative assumptions about the appropriate transaction counts to use as the basis for each calculation.

[redacted]

Exchange Seller," *Google Ad Manager Help*, June 13, 2016, available at https://support.google.com/admanager/answer/7421657?sjid=10086602547051235141-NA#zippy=%2Cjune-change-history-update-safeframe-for-creative-types-deal-check-bid-filter-apply-per-query-revenue-share-optimization. (last accessed July 25, 2024) (under the Q2 2016 Ad Exchange release stating "New Ad Exchange control for applying per-query revenue share optimization") (emphasis added). Similarly, a presentation for publishers dated December 2016 included a slide explaining that "[r]evenue share based optimizations help publishers make more revenue by adjusting Google's revenue share *up or down* to increase winrate." GOOG-DOJ-03071474 at -476 (emphasis added). While this presentation included an example where "RSBO" (which appears to be an alternative Google name for DRS v2) reduced AdX's revenue share to 11 percent, the speaker notes explain that "[i]n other queries RSBO might increase the rev share." *Id.* at -477. Finally, Google offered publishers alternative options concerning how they would be billed for their contracted AdX revenue share, which implicitly revealed that the revenue share could be above or below 20% (or the publisher-specific contracted share). In particular, publishers could opt to pay the contracted revenue share (i) on a "per query" basis, or (ii) on average over all queries during each billing period. See GOOG-DOJ-14718514. When offered this choice, at least some publishers would logically conclude that, under the second option, the AdX revenue share could differ across individual queries, but both options would have the same revenue share on average. In other words, under the "per query" option, deviations from the contracted revenue share would be zero, and under the second option, the revenue share could be higher than the contracted rate on some queries and lower on others. Publishers that realized this simple implication of the two options would not have been deceived.

Appendix E: Statutes of Limitations for DTPA Claims

362. I understand that the plaintiff States' respective statutes of limitations define intervals of time following disclosures of the challenged programs during which DTPA violations can be alleged and penalties claimed.

363. Counsel for Google has provided me the information reported in Table E1 below. I used that information to determine which states can claim DTPA civil penalties for the alleged deception about each of the programs at issue, based on the time the alleged deception ended and the "critical date" from the table. In particular, if $d(p)$ is the month when the alleged deception pertaining to program p ended, and $c(s)$ is the plaintiff States (s)'s critical date reported in the table below:

   a. If $d(p) \geq c(s)$, then state s can claim penalties for the alleged deception related to program p.

   b. If $d(p) < c(s)$, then state s cannot claim penalties for the alleged deception related to program p.

Table E1
DTPA Statutes of Limitations

Plaintiff State	DTPA Statute of Limitations	Basis for DTPA Statute of Limitations	Critical Date[1]
Alaska	6 years	AS § 09.10.120; *see also* Pls.' Appendix A[2] at 1	12/16/2014
Arkansas	5 years	Ark. Code Ann. § 4-75-217(a); *see also* Pls.' Appendix A at 1	12/16/2015
Florida	4 years	Fla. Stat. Ann. § 501.207(5)	12/16/2016
Idaho	4 years	Idaho Code § 5-224; *see also* Pls.' Appendix A at 1	12/16/2016
Indiana	2 years	Ind. Code § 24-5-0.5-5(b); *see also* Pls.' Appendix A at 1-2	12/16/2018
Kentucky	2 years	Ky. Rev. Stat. § 367.220(5)	12/16/2018
Missouri	3 years	Mo. Ann. Stat. § 516.130(2)	12/16/2017
Montana	2 years	Mont. Code Ann. § 27-2-211; *see also* Pls.' Appendix A at 2-3	12/16/2018
Nevada	4 years	Nev. Rev. Stat. § 11.190(2)(d) (2017); *see also* Pls.' Appendix A at 3	12/16/2016
North Dakota	2 years	N.D. Cent. Code Ann. § 28-01-18(2)	12/16/2018
Puerto Rico	4 years	10 L.P.R.A. § 268(c); *see also* Pls.' Appendix A at 3	12/16/2016
South Carolina	3 years	S.C. Code § 39-5-150; *see also* Pls.' Appendix A at 3-4	12/16/2017
South Dakota	4 years	SDCL § 37-24-33; *see also* Pls.' Appendix A at 4	12/16/2016
Utah	5 years	Utah Code § 13-2-6(6)(b); *see also* Pls.' Appendix A at 4	12/16/2015

Notes: [1] This table does not address statutes of limitations applicable to DTPA claims under Louisiana, Mississippi, or Texas law. [2] For each state, a "Critical Date" is calculated as the date corresponding to the number of years prior to the filing date of Plaintiff States' original complaint (December 16, 2020) that is equal to the length of that state's statute of limitations for DTPA claims. If allegedly deceptive conduct was publicly disclosed prior to a Plaintiff State's Critical Date, then that plaintiff State should not be able to recover civil penalties based on that conduct under that Plaintiff State's DTPA. [3] "Pls.' Appendix A" refers to Appendix A to Plaintiff States' Response in Opposition to Google LLC's Motion to Dismiss Under Rule 12(b)(6), *State of Texas et al. v. Google LLC*, No. 4:20-cv-00957-SDJ (E.D. Tex. Feb. 21, 2014), ECF No. 260-1.

Appendix F: De-Duplication Methodology

364. When counting both affected and unaffected transactions, removing duplicates is a simple exercise: the de-duplicated transaction count equals the count of transactions associated with Bernanke/Alchemist because: (i) among the programs at issue, Bernanke/Alchemist was the first to be introduced; (ii) the alleged deception concerning Bernanke/Alchemist ended in October 2021, so no states are time-barred barred from recovering penalties based on that alleged deception.

365. However, when unaffected transactions are excluded, removing duplicates becomes a more complex exercise because information is unavailable on which specific transactions are impacted by each of the programs at issue. To address this data limitation, I assume that the likelihood that a particular program impacts a transaction is independent from the likelihood that other programs affect the same transaction, conditional on state, month, and demand source (Google Ads, DV360, or Authorized Buyers).

366. Specifically, I proceed as follows. For each month (m), state (s), and demand source (d), I start from the count of de-duplicated transactions from row 6 of Table C1. These transactions represent the total number of transactions that could *potentially* be affected by a program; I refer to them as $Q(m, s, d)$. For each program, I estimate the number of affected transactions, as explained in Section IV.G, and then calculate the likelihood that a transaction is affected by the program as the number of affected transactions divided by $Q(m, s, d)$. I refer to these probabilities as $p(m, s, d|program)$.

367. Under an assumption of independence, the likelihood that a transaction is not affected by any of the programs at issues is $\prod_{\substack{k\ is\ one\ of\ the \\ programs\ at\ issue}} \left(1 - p(m, s, d|k)\right)$. This in turn implies that the probability that a transaction is affected by one or more of the programs at issue is $1 - \prod_{\substack{k\ is\ one\ of\ the \\ programs\ at\ issue}} \left(1 - p(m, s, d|k)\right)$. The de-duplicated number of affected transactions is simply the product of $Q(m, s, d)$ (namely, the total number of transactions that could potentially be affected) and the probability that a transaction is affected by at least one program.

Month	m
State	s
Demand Source	d
Total Count (Including Unaffected)	$Q(m, s, d)$
Likelihood of Being Affected by a Program:	
RPO	$p(m, s, d \mid RPO)$
DRS v1	$p(m, s, d \mid DRSv1)$
DRS v2	$p(m, s, d \mid DRSv2)$
Second Price Bernanke	$p(m, s, d \mid Second\ Price\ Bernanke)$
Alchemist (First Price Bernanke)	$p(m, s, d \mid Alchemist)$
Equal Foot. (NBA & Bernanke)	$p(m, s, d \mid Equal\ Footing)$
De-Duplicated Count	$Q(m, s, d) \times \left(1 - \prod_{\substack{k\ is\ one\ of\ the \\ programs\ at\ issue}} \left(1 - p(m, s, d \mid k)\right) \right)$

Appendix G: Settlement Payments and Fines Relied Upon by Mr. Andrien

Table G1
Settlement Payments and Fines Relied Upon by Mr. Andrien

Case Number	Jurisdiction	Type of Case	Reason for Google Payment	Date When Decision or Settlement was Imposed	Amount of Payment (USD)
[1]	EU	Privacy	Fine	3/7/2011	$140,330
[2]	EU	Privacy	Fine	4/22/2013	$189,185
[3]	EU	Privacy	Fine	12/19/2013	$1,230,086
[4]	EU	Privacy	Fine	1/8/2014	$203,789
[5]	EU	Privacy	Fine	4/3/2014	$1,370,502
[6]	EU	Privacy	Fine	3/24/2016	$111,720
[7]	Russia	Antitrust	Settlement	4/17/2017	$7,828,669
[8]	EU	Antitrust	Fine	6/27/2017	$2,740,384,711
[9]	India	Antitrust	Fine	2/8/2018	$21,112,765
[10]	EU	Antitrust	Fine	9/14/2022	$4,120,000,000
[11]	Turkey	Antitrust	Fine	9/20/2018	$14,811,297
[12]	EU	Privacy	Fine	1/21/2019	$56,852,237
[13]	EU	Antitrust	Fine	3/20/2019	$1,691,353,620
[14]	Turkey	Antitrust	Fine	2/16/2020	$16,242,299
[15]	EU	Privacy	Fine	7/14/2020	$684,365
[16]	Turkey	Antitrust	Fine	11/13/2020	$25,675,842
[17]	EU	Privacy	Fine	12/7/2020	$121,383,026
[18]	Turkey	Antitrust	Fine	4/14/2021	$36,582,734
[19]	EU	Antitrust	Fine	5/13/2021	$123,069,664
[20]	EU	Antitrust	Settlement	6/7/2021	$268,373,342
[21]	EU	Antitrust	Fine	7/13/2021	$590,576,417
[22]	South Korea	Antitrust	Fine	9/14/2021	$176,640,000
[23]	EU	Privacy	Fine	11/26/2021	$11,200,000
[24]	EU	Privacy	Fine	1/6/2022	$169,590,563
[25]	EU	Privacy	Fine	5/18/2022	$10,499,241
[26]	Australia	Privacy	Fine	8/12/2022	$42,638,374
[27]	South Korea	Privacy	Fine	9/14/2022	$49,722,941
[28]	India	Antitrust	Fine	10/20/2022	$161,855,268
[29]	India	Antitrust	Fine	10/25/2022	$113,000,000
[30]	US	Improper Advertising	Settlement	8/24/2011	$500,000,000
[31]	US	Failure to respond to Letter of Inquiry	Fine	4/16/2012	$25,000
[32]	US	Privacy	Settlement	8/9/2012	$22,500,000
[33]	US	Privacy	Settlement	3/12/2013	$7,000,000
[34]	US	Privacy	Settlement	11/18/2013	$17,000,000
[35]	US	Campaign Finance	Settlement	12/18/2018	$217,000
[36]	US	Privacy	Settlement	9/4/2019	$170,000,000
[37]	US	Campaign Finance	Settlement	6/17/2021	$423,659
[38]	US	Privacy	Settlement	12/13/2021	$3,850,000
[39]	US	Litigation Misconduct	Sanction	7/15/2022	$971,715
[40]	US	Privacy	Settlement	10/4/2022	$85,000,000
[41]	US	Privacy	Settlement	11/14/2022	$391,500,000
[42]	US	Privacy	Settlement	11/28/2022	$9,400,000
[43]	US	Privacy	Settlement	12/29/2022	$9,500,000
[44]	US	Privacy	Settlement	12/30/2022	$20,000,000
[45]	US	Litigation Misconduct	Sanction	3/20/2023	$79,000
[46]	US	Litigation Misconduct	Sanction	3/28/2023	N/A
[47]	US	Privacy	Settlement	9/15/2023	$155,000,000
[48]	US	Privacy	Settlement	4/1/2024	$5,000,000,000

Notes: The matters listed in lines [1] - [46] of this table are cited in Oracle's draft complaint to the Federal Trade Commission. See Oracle Corporation, "Draft Complaint In the Matter of Alphabet, Inc.," May 8, 2023, at Exhibit B ("Oracle Complaint"). The matters listed in lines [47] and [48] of this table are described in Mr. Andrien's Report but are not listed in Oracle Complaint. See Andrien Report at ¶ 125 and footnotes 310-311. Where possible, I use the same third-party sources as cited in Exhibit B to the Oracle Complaint, but there are three discrepancies with the figures provided in the Oracle Complaint. First, in Table G1, row 10, both I and the Oracle Complaint (at B-2) cite to Reid, Jenni, "Google Loses Appeal Over EU Antitrust Ruling, But Fine Cut to $4.12 Billion," *CNBC*, September 14,

2022, available at https://www.cnbc.com/2022/09/14/eu-court-backs-antitrust-ruling-against-google-but-reduces-fine.html (last accessed July 25, 2024). However, while the Oracle Complaint lists the "Date Imposed" as July 18, 2018, the source notes that the fine was finalized after an appeal on September 14, 2022. I use the latter date as it is the "Date When Decision or Settlement was Imposed" and use the associated USD conversion, as reflected in the CNBC article and original Oracle Complaint source. By not updating the date, the Oracle Complaint appears to use an outdated currency conversion rate to calculate the US Dollar amount. I have corrected this in my calculations, as substantiated by the CNBC article. This results in a $682,668,982 reduction in the associated fine amount. Second, rather than relying on the Oracle Complaint currency conversions, I chose to rely on the US Dollar value as represented in the relevant third-party sources. This results in a net difference, for rows 1-46, of $683,944,608 between my fine estimates and those provided in Exhibit B of the Oracle Complaint. Specifically, for the 2021 South Korean Android case in row 22, my source shows the fine to be $751,438 lower than the Oracle Complaint's figure. See Table G1, row 22 and source [22]; Oracle Complaint at B-3. For the 2022 India Google Play case in row 29, my source shows the fine to be $524,188 lower than the Oracle Complaint's figure. See Table G1, row 29 and source [29]; Oracle Complaint at B-4.

Sources:
Draft complaint to Federal Trade Commission by Oracle Corporation, May 8, 2023.
[1] Atwill, Nicole, "France: Google Fined by National Commission on Information Technology and Liberty," *Library of Congress*, March 25, 2011, available at https://www.loc.gov/item/global-legal-monitor/2011-03-25/france-google-fined-by-national-commission-on-information-technology-and-liberty/ (last accessed July 25, 2024).
[2] "German State Fines Google for Street View Data Breach," *Reuters*, April 22, 2013, available at https://www.reuters.com/article/google-privacy/german-state-fines-google-for-street-view-data-breach-idINDEE93L0ED20130422/ (last accessed July 25, 2024).
[3] "Spain Privacy Watchdog Fines Google for Breaking Data Law," *Reuters*, December 19, 2013, available at https://www.reuters.com/article/us-spain-google-privacy/spain-privacy-watchdog-fines-google-for-breaking-data-law-idUSBRE9BI12Z20131219/ (last accessed July 25, 2024).
[4] Brian, Matt, "France Slaps Google with $204,000 Fine for Violating Privacy Laws," *Engadget*, January 8, 2014, https://www.engadget.com/2014-01-08-google-privacy-cnil-fine.html (last accessed July 25, 2024).
[5] Levine, Barry, "Italy Slaps Google's Hand with $1.4M Fine for not Clearly Labeling Street View Cars," *Venture Beat*, April 4, 2014, available at https://venturebeat.com/business/italy-slaps-googles-hand-with-1-4m-fine-for-not-labeling-street-view-cars/ (last accessed July 25, 2024).
[6] Fioretti, Julia, "France Fines Google Over 'Right to Be Forgotten'," *Reuters*, March 24, 2016, available at https://www.reuters.com/article/idUSKCN0WQ1WX/ (last accessed July 25, 2024).
[7] Perez, Sarah, "Google Reaches $7.8 Million Settlement in its Android Antitrust Case in Russia," *TechCrunch*, April 17, 2017, available at https://techcrunch.com/2017/04/17/google-reaches-7-8-million-settlement-in-its-android-antitrust-case-in-russia/ (last accessed July 25, 2024).
[8] "Antitrust: Commission Fines Google €2.42 Billion for Abusing Dominance as Search Engine by Giving Illegal Advantage to Own Comparison Shopping Service," *European Commission*, June 27, 2017, available at https://ec.europa.eu/commission/presscorner/detail/en/IP_17_1784 (last accessed July 25, 2024).
[9] Kalra, Aditya and Aditi Shah, "Competition Commission of India Fines Google for Abusing Dominant Position," *Reuters*, February 8, 2018, available at https://www.reuters.com/article/india-google-antitrust-idINKBN1FS29Z/ (last accessed July 25, 2024).
[10] Reid, Jenni, "Google Loses Appeal Over EU Antitrust Ruling, But Fine Cut to $4.12 Billion," *CNBC*, September 14, 2022, available at https://www.cnbc.com/2022/09/14/eu-court-backs-antitrust-ruling-against-google-but-reduces-fine.html (last accessed July 25, 2024).
[11] Richards, Matt, "Google Hit by Android Fine in Turkey," *Global Competition Review*, September 21, 2018, available at https://globalcompetitionreview.com/article/google-hit-android-fine-in-turkey (last accessed July 25, 2024).
[12] Rosemain, Mathieu, "France Fines Google $57 Million for European Privacy Rule Breach," *Reuters*, January 21, 2019, available at https://www.reuters.com/article/us-google-privacy-france/france-fines-google-57-million-for-european-privacy-rule-breach-idUSKCN1PF208/ (last accessed July 25, 2024).
[13] "Antitrust: Commission Fines Google €1.49 Billion for Abusive Practices in Online Advertising," *European Commission*, March 20, 2019, available at https://ec.europa.eu/commission/presscorner/detail/en/IP_19_1770 (last accessed July 25, 2024).
[14] "Turkey Fines Google $16mn for Violating Competition Rules," *bne IntelliNews*, February 16, 2020, available at

https://www.intellinews.com/turkey-fines-google-16mn-for-violating-competition-rules-176710/ (last accessed July 25, 2024).
[15] "Belgian DPA Imposes €600.000 Fine on Google Belgium for not Respecting the Right to be Forgotten of a Belgian Citizen, and for Lack of Transparency in its Request Form to Delist," *European Data Protection Board*, July 16, 2020, available at https://www.edpb.europa.eu/news/national-news/2020/belgian-dpa-imposes-eu600000-fine-google-belgium-not-respecting-right-be_en (last accessed July 25, 2024).
[16] Cantekin, Kayahan, "Turkey: Competition Authority Fines Google and Subsidiaries for Abuse of Market Dominance," *Library of Congress*, December 8, 2020, available at https://www.loc.gov/item/global-legal-monitor/2020-12-08/turkey-competition-authority-fines-google-and-subsidiaries-for-abuse-of-market-dominance/ (last accessed July 25, 2024).
[17] "Google Fined £91m Over Ad-Tracking Cookies," *BBC*, December 10, 2020, available at https://www.bbc.com/news/technology-55259602 (last accessed July 25, 2024).
[18] "Turkey fines Google for Abusing Dominant Position," *Reuters*, April 14, 2021, available at https://www.reuters.com/technology/turkey-fines-google-abusing-dominant-position-2021-04-14 (last accessed July 25, 2024).
[19] "Italy fines Google for excluding Enel e-car app from Android Auto," *Reuters*, May 13, 2021, available at https://www.reuters.com/technology/italys-antitrust-fines-google-102-million-euros-abuse-dominant-position-2021-05-13/ (last accessed July 25, 2024).
[20] "The Autorité de la Concurrence Hands Out a €220 Millions Fine to Google for Favouring its Own Services in the Online Advertising Sector," *Autorité de la Concurrence*, June 7, 2021, available at https://www.autoritedelaconcurrence.fr/en/communiques-de-presse/autorite-de-la-concurrence-hands-out-eu220-millions-fine-google-favouring-its (last accessed July 25, 2024).
[21] "Rémunération des Droits Voisins: l'Autorité Sanctionne Google à Hauteur de 500 Millions d'Euros Pour le Non-Respect de Plusieurs Injonctions," *Autorité de la Concurrence*, July 13, 2021, available at https://www.autoritedelaconcurrence.fr/fr/communiques-de-presse/remuneration-des-droits-voisins-lautorite-sanctionne-google-hauteur-de-500 (last accessed July 25, 2024).
[22] Yang, Heekyong,"S.Korea Fines Google $177 mln for Blocking Android Customisation," *Reuters*, September 14, 2021, available at https://www.reuters.com/technology/skorean-antitrust-agency-fines-google-177-mln-abusing-market-dominance-2021-09-14/ (last accessed July 25, 2024).
[23] "Italy's Antitrust Regulator Fines Google, Apple Over Data Use," *Reuters*, November 29, 2021, available at https://www.reuters.com/technology/italys-antitrust-fines-google-apple-commercial-use-data-2021-11-26/ (last accessed July 25, 2024).
[24] Lomas, Natasha, "France Spanks Google $170M, Facebook $68M Over Cookie Consent Dark Patterns," *TechCrunch*, January 6, 2022, available at https://techcrunch.com/2022/01/06/cnil-facebook-google-cookie-consent-eprivacy-breaches/ (last accessed July 25, 2024).
[25] "AEPD Hands Google 10M Euro GDPR Fine," *IAPP*, May 18, 2022, available at https://iapp.org/news/a/aepd-hands-google-10m-euro-gdpr-fine/ (last accessed July 25, 2024).
[26] "Google LLC to Pay $60 Million for Misleading Representations," *Australian Competition & Consumer Commission*, August 12, 2022, available at https://www.accc.gov.au/media-release/google-llc-to-pay-60-million-for-misleading-representations (last accessed July 25, 2024).
[27] Choi, Soo-Hyang and Joyce Lee, "S.Korea Fines Google, Meta Billions of Won for Privacy Violations," *Reuters*, September 15, 2022, https://www.reuters.com/technology/skorea-fines-google-meta-over-accusations-privacy-law-violations-yonhap-2022-09-14/ (last accessed July 25, 2024).
[28] Kalra, Aditya and Munsif Vengattil, "Google Fined $162 mln by India Antitrust Watchdog for Abuse of Android Platform," *Reuters*, October 20, 2022, available at https://www.reuters.com/world/india/india-competition-regulator-fines-google-16195-mln-anti-competitive-practices-2022-10-20/ (last accessed July 25, 2024).
[29] Paramasivam, Praveen and Aditya Kalra, "India Orders Google to Allow Third-Party Payments, Slaps on Another Fine," *Reuters*, October 26, 2022, available at https://www.reuters.com/technology/india-fines-google-113-million-second-antitrust-penalty-this-month-2022-10-25/ (last accessed July 25, 2024).
[30] "Google Forfeits $500 Million Generated by Online Ads & Prescription Drug Sales by Canadian Online Pharmacies," *U.S. Department of Justice*, August 24, 2011, available at https://www.justice.gov/opa/pr/google-forfeits-500-million-generated-online-ads-prescription-drug-sales-canadian-online (last accessed July 25, 2024).
[31] "Enforcement Bureau Issues $25,000 NAL to Google Inc," *Federal Communications Commission*, File No. EB-10-IH-4055, April 13, 2012, available at https://docs.fcc.gov/public/attachments/DA-12-592A1.pdf (last accessed July 25, 2024).

[32] "Google Will Pay $22.5 Million to Settle FTC Charges it Misrepresented Privacy Assurances to Users of Apple's Safari Internet Browser," *Federal Trade Commission*, August 9, 2012, available at https://www.ftc.gov/news-events/news/press-releases/2012/08/google-will-pay-225-million-settle-ftc-charges-it-misrepresented-privacy-assurances-users-apples (last accessed July 25, 2024); Order Approving Stipulated Order for Permanent Injunction and Civil Penalty Judgment at 2, 9, *U.S. v. Google Inc.*, No. 3:13-cv-04177 (N.D. Cal. 2012), ECF No. 30 ("Google 'denies any violation of the FTC Order,' and states that it stipulates to the Proposed Order 'freely and without coercion.'" and the "Court finds the Proposed Order with Google's denial of liability to be fair, adequate and reasonable.").
[33] "Google to Pay $7 million in Multistate Settlement over Street View," *Washington State Office of the Attorney General*, March 11, 2013, available at https://www.atg.wa.gov/news/news-releases/google-pay-7-million-multistate-settlement-over-street-view (last accessed July 25, 2024); Assurance of Voluntary Compliance, Washington Office of the Attorney General, at 8 (2013) ("This Assurance is for settlement purposes only, and . . . neither the fact of, nor any provision contained in, this Assurance nor any action taken hereunder, shall constitute, be construed as, or be admissible in evidence as any admission of the validity of any claim or any fact alleged in any other pending or subsequently filed action or of any wrongdoing, fault, violation of law, or liability of any kind on the part of the Released Parties or admission by any Released Parties of the validity or lack thereof of any claim, allegation, or defense asserted in any other action.").
[34] Miller, Claire C., "Google to Pay $17 Million to Settle Privacy Case," *New York Times*, November 18, 2013, available at https://www.nytimes.com/2013/11/19/technology/google-to-pay-17-million-to-settle-privacy-case.html (last accessed July 25, 2024); Assurance of Voluntary Compliance, *In re Google Inc.*, at 5 (Dist. Ct. NV. 2013) ("Google denies any and all liability for the Covered Conduct.").
[35] "Google, Facebook to Pay More Than $400k to Washington State in Campaign Finance Cases," *Washington State Office of the Attorney General*, December 18, 2018, available at https://www.atg.wa.gov/news/news-releases/google-facebook-pay-more-400k-washington-state-campaign-finance-cases (last accessed July 25, 2024); Judgment Summary (RCW 4.64.030), *State of Washington v. Google, Inc.*, No. 18-2-14130-3, December 17, 2018, available at https://agportal-s3bucket.s3.amazonaws.com/GoogleJudgment-20181218_0.pdf (last accessed July 25, 2024).
[36] "Google and YouTube Will Pay Record $170 Million for Alleged Violations of Children's Privacy Law," *Federal Trade Commission*, September 4, 2019, available at https://www.ftc.gov/news-events/news/press-releases/2019/09/google-youtube-will-pay-record-170-million-alleged-violations-childrens-privacy-law (last accessed July 25, 2024); Stipulated Order Permanent Injunction and Civil Penalty Judgment at 2, *FTC and the State of New York v. Google LLC and Youtube LLC*, 1:19-cv-02642 (D.D.C. 2019), ECF No. 5 ("Defendants neither admit nor deny any of the allegations in the Complaint[.]").
[37] "AG Ferguson: Google Will Pay More Than $423,000 Over Repeated Violations of Washington Campaign Finance Law," *Washington State Office of the Attorney General*, June 17, 2021, available at https://www.atg.wa.gov/news/news-releases/ag-ferguson-google-will-pay-more-423000-over-repeated-violations-washington (last accessed July 25, 2024).
[38] Global Settlement Agreement, *Balderas v. Tiny Lab Productions, et al.*, No. 1:18-cv-00854-MV-JFR, *Balderas v. Google LLC*, No. 1:20-cv-00143-NF-KHR, December 10, 2021, available at https://business.cch.com/CybersecurityPrivacy/GoogleNMSettlement.pdf (last accessed July 25, 2024); *Id.* at 2 ("Google has denied and continues to deny each allegation and all charges of wrongdoing or liability of any kind whatsoever asserted or that could have been asserted in the Civil Actions.").
[39] Scarcella, Mike, "Google Hit with $971,000 Sanction for Litigation Misconduct in Privacy Suit," *Reuters*, July 18, 2022, available at https://www.reuters.com/legal/transactional/google-hit-with-971k-sanction-litigation-misconduct-privacy-suit-2022-07-15/ (last accessed July 25, 2024).
[40] "Attorney General Mark Brnovich Achieves Historic $85 Million Settlement with Google," *Arizona State Office of the Attorney General*, October 4, 2022, available at https://www.azag.gov/press-release/attorney-general-mark-brnovich-achieves-historic-85-million-settlement-google (last accessed July 25, 2024); Settlement Agreement, *State of Arizona ex rel. Mark Brnovich v. Google LLC*, No. CV2020-006219, at 2 (AZ Super. Ct. 2020) ("Parties agree that nothing in this Agreement shall constitute an admission of any wrongdoing or admission of any violations of law by Defendant.").
[41] Kang, Cecilia, "Google Agrees to $392 Million Privacy Settlement With 40 States," *The New York Times*, November 14, 2022, available at https://www.nytimes.com/2022/11/14/technology/google-privacy-settlement.html (last accessed July 29, 2024); Assurance of Voluntary Compliance, *Commonwealth of PA ex rel. Josh Shapiro v. Google LLC*, at 6 (Nov. 14, 2022) ("GOOGLE does not admit to the Findings set forth in Paragraphs 4 through 39

below, and does not admit to any violation of or liability arising from any federal, state, or local laws in stipulating to the entry of this Assurance.”).
[42] “FTC, States Sue Google and iHeartMedia for Deceptive Ads Promoting the Pixel 4 Smartphone,” *Federal Trade Commission*, November 28, 2022, available at https://www.ftc.gov/news-events/news/press-releases/2022/11/ftc-states-sue-google-iheartmedia-deceptive-ads-promoting-pixel-4-smartphone (last accessed July 25, 2024); Decision and Order Against Respondent Google LLC, *In re Google LLC and iHeartMedia Inc.*, FTC No. C-4783, No. 202-3092, at 1 (2023) (“The Consent Agreement includes: 1) statements by Respondent that it neither admits nor denies any of the allegations in the Complaint.”).
[43] Gans, Jared, “Google to pay $29.5 Million to Settle DC, Indiana Lawsuits Over Location Tracking,” *The Hill*, December 31, 2022, available at https://thehill.com/policy/technology/3794301-google-to-pay-29-5-million-to-settle-dc-indiana-lawsuits-over-location-tracking/ (last accessed July 25, 2024); Settlement Agreement, *District of Columbia v. Google LLC*, No. 2022-CA-000330 B, at 5 (D.C. Super. Ct. 2022) (“GOOGLE denies the allegations and characterizations of Google’s business practices set forth in the Complaint, and denies any violation of or liability arising from any federal, state, or DISTRICT laws in stipulating to the entry of this Agreement.”).
[44] “Google to Pay Indiana $20 Million to Resolve Tracking Privacy Lawsuit,” *PBS News*, December 30, 2022, available at https://www.pbs.org/newshour/economy/google-to-pay-indiana-20-million-to-resolve-tracking-privacy-lawsuit (last accessed July 25, 2024); Settlement Agreement, *State of Indiana v. Google LLC*, No. 49D01-2201-PL-002399, at 6 (2022) (“[T]he Parties agree that nothing in this Agreement shall constitute an admission of any wrongdoing or admission of any violations of law by GOOGLE.”).
[45] Scarcella, Mike, “US court sanctions Google in privacy case, company's second legal setback in days,” *Reuters*, March 30, 2023, available at https://www.reuters.com/legal/us-court-sanctions-google-privacy-case-companys-second-legal-setback-days-2023-03-30/ (last accessed July 25, 2024).
[46] Findings of Fact and Conclusions of Law Re Chat Preservation, *In Re Google Play Store Antitrust Litigation*, Case No. 3:21-md-02981-JD, (N.D. Cal. Mar. 28, 2023), ECF No. 469.
[47] Stempel, Jonathan, “Google to Pay $155 Million in Settlements Over Location Tracking,” *Reuters*, September 15, 2023, available at https://www.reuters.com/legal/google-pay-155-million-settlements-over-location-tracking-2023-09-15/ (last accessed July 25, 2024); Proposed Settlement Agreement, *People of the State of California v. Google LLC*, Case No. 23-CV-422424, at 2 (September 2023) (“[W]ithout GOOGLE admitting any liability[.]”).
[48] Alba, Davey, “Google Agrees to Delete Users’ ‘Incognito’ Browsing Data in Lawsuit Settlement,” *TIME*, April 1, 2024, https://time.com/6962521/google-incognito-lawsuit-data-settlement/ (last accessed July 25, 2024); Plaintiffs’ Unopposed Motion for Final Approval of Class Action Settlement at 3 footnote 2, *Brown et al. v. Google LLC*, No. 4:20-cv-03664 (N.D. Cal. April 1, 2024), ECF No. 1096 (“Google supports final approval of the settlement, but disagrees with the legal and factual characterizations contained in the Motion.”).

Appendix H: Overview of Google Datasets

368. In this Appendix, I list the Bates numbers associated with the Google datasets that I analyze and describe how various variables were constructed. Note that text enclosed in angular brackets (“<text>”) indicates original variable names as they appear in the raw data production.

[redacted]

[redacted]

[redacted]

Appendix I: Methodology to Account for Advertisers and Publishers That Are Unidentified in the Data

369. *Advertisers*. [redacted]

370. To account for these advertisers, I proceed as follows. I calculate the number of advertisers in the Google Ads and DV360 data, which provide a more complete picture of the advertiser identity. Let (i) N(GA, GA) be the number of Google Ads advertisers in the Google Ads data, (ii) N(GA, AdX) be the number of Google Ads advertisers in the AdX data, (iii) N(DV, DV) be the number of DV360 advertisers in the DV360 data; and (iv) N(DV, AdX) be the number of DV360 advertisers in the AdX data. I estimate an adjustment factor equal to R = (N(GA, GA) + N(DV, DV)) / (N(GA, AdX) + N(DV, AdX)). I then multiply the count of advertisers in the AdX data [redacted] by R.

371. *Publishers*. [redacted]

372. I calculate the percentage of impressions accounted for by publishers that are identified in the data; then divide the count of these publishers by this percentage. In other words, I "inflate" the count of publishers that Google does identify to account for the publishers that are not identified in the data.

[580] GOOG-AT-MDL-001776806. Calculations available in workpaper "DTPA Transaction Count Tables.xlsx", for both shares of unidentified advertisers and publishers.

EXHIBIT 5

UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF TEXAS
SHERMAN DIVISION

THE STATE OF TEXAS, ET AL., **Plaintiffs,** **v.** **GOOGLE LLC,** **Defendant.**	CIVIL NO. 4:20-CV-957-SDJ

EXPERT REPORT OF DOUGLAS SKINNER

July 30, 2024

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I. Qualifications

1. I am the Sidney Davidson Distinguished Service Professor of Accounting at the University of Chicago, Booth School of Business. I have been a tenured full professor at the University of Chicago since 2005, and previously served as Deputy Dean for Faculty and Interim Dean. Prior to my appointment at the University of Chicago, I was the KPMG Professor of Accounting at the Ross School of Business, University of Michigan, where I held tenured and tenure-track appointments from 1989 until 2005 and served as chair of the accounting department.

2. I hold a B. Econ. (First Class Honors in Accounting and Finance) from Macquarie University in Sydney, Australia and an M.S. and Ph.D. (Applied Economics: Accounting and Finance) from the University of Rochester. I have taught undergraduate upper-class students, full-time and part-time MBA students, Executive MBA ("EMBA") students, executives, consultants, and Ph.D. students. I have taught introductory financial accounting, intermediate financial accounting, accounting for financial instruments, corporate financial reporting and analysis, financial statement analysis, managerial (cost) accounting, corporate finance, investments, valuation, and empirical methods in accounting research. Most recently, I have taught Corporate Finance and Valuation, as well as Managerial Accounting, in the University of Chicago's EMBA program at campuses in Chicago, London, and Hong Kong and a Ph.D. class in empirical capital markets research.

3. From 2006 to 2021 I was Senior Editor of the *Journal of Accounting Research*, one of the preeminent academic accounting journals in the world. Before moving to Chicago, I was Co-Editor of the *Journal of Accounting and Economics*, also one of the world's leading academic accounting journals. I also served as editor of the *Review of Accounting Studies*, and for several terms on the editorial board of *The Accounting Review*. I am a member of the American Accounting Association and the American Finance Association. I frequently present my research at major accounting and finance conferences and prominent universities. I have supervised doctoral students who have accepted faculty positions at major business schools around the world including Stanford, Harvard, Wharton, MIT, Columbia, Cornell, Michigan, Yale, and Chicago.

4. I have published research on a variety of topics in accounting, auditing, capital markets, investments, and corporate finance, including how security prices respond to corporate

disclosures (including event studies of earnings disclosures); corporate managers' incentives to disclose forward-looking information, including guidance; the payout practices of public companies (i.e., firms' dividend and repurchase decisions); corporate managers' financial reporting, disclosure, and capital management decisions; how accounting information is used in contracts between the various corporate stakeholders; and the nature of corporate debt agreements.

5. My research is published in leading accounting and finance journals, including *The Accounting Review*, the *Journal of Accounting and Economics*, the *Journal of Accounting Research*, the *Journal of Business*, *The Journal of Finance*, and the *Journal of Financial Economics*. My research has been featured in articles in *The Wall Street Journal*, *The New York Times*, *The Financial Times*, *The Economist*, and *Bloomberg Businessweek*.

6. I serve as an Independent Trustee and chair of the Audit Committee for Harbor Funds, Harbor Funds II, and Harbor ETF Trust.

7. A copy of my curriculum vitae, including my publications, is attached as **Appendix A**. A list of my previous expert work, including reports, depositions, and trial testimony, over the past ten years is attached as **Appendix B**.

II. Scope of Assignment

8. I have been retained by counsel for Google LLC ("Google") to review and respond to certain conclusions in the expert report submitted by Jeffrey S. Andrien, dated June 7, 2024, on behalf of plaintiffs the State of Texas, et al. ("Plaintiffs"),[1] and to provide opinions regarding the profitability of Google's ad tech business, i.e., Display & Video, Apps and Analytics ("Google DVAA" or "DVAA").[2]

9. Specifically, I have been asked to review and respond to those portions of the Andrien Report that include his calculations, findings, and opinions related to the financial performance and financial position of Alphabet, Google's advertising business, and Google DVAA. Further, I have been asked to be prepared to provide rebuttal testimony and opinions relating

[1] Expert Report of Jeffrey S. Andrien, June 7, 2024, and Backup Materials ("Andrien Report").

[2] *See, e.g.*, GOOG-AT-MDL-004326981 at -6989. I understand that in internal documents Google DVAA is sometimes referred to as "Display and Video" or just "Display." *See, e.g.*, GOOG-AT-MDL-009017821 at -7822. I further understand that Google has been moving away from the DVAA nomenclature. *See, e.g.*, Deposition of Jessica Mok, November 10, 2023 ("Mok Deposition"), p. 63:4–14 ("AVID is the team name that -- the name of the team in August 2022, which is the time frame of this file. … Q Is it the team name now? A Yes. … Q Do you know what the team name was before? A DVAA."). I use the terms DVAA and Google DVAA interchangeably to refer to the collection of Google's ad tech products historically grouped under "Display & Video, Apps and Analytics." I also refer to this collection of products as Google's "ad tech business."

to Plaintiffs' witnesses to the extent that they address the financial performance, profitability, and financial position of Alphabet and Google, including Google's ad tech business, and related issues. I understand that Professor Steven Wiggins is evaluating Mr. Andrien's opinions regarding the appropriate civil penalty the trier of fact should impose on Google in the event it finds Google liable for the deceptive trade practices alleged by Plaintiffs; I do not express an opinion on that aspect of the Andrien Report. In addition, I have been asked by counsel to summarize measures of the cost of revenue and gross profit for Alphabet (and Google) and DVAA for fiscal years 2013 to 2023, to the extent such information is available.

10. In formulating my opinions, I have relied on my knowledge, prior experience, academic research on relevant topics, experience as a journal editor reviewing academic research articles, and formal training in economics, finance, and accounting. A list of the materials I relied upon in preparing this report is attached as **Appendix C**.

11. I am being compensated at my standard billing rate of $1,125 per hour in this case. I have been assisted in this matter by staff of Cornerstone Research, who worked under my direction. I receive compensation from Cornerstone Research based on its collected staff billings for its support of me in this matter. Neither my compensation in this matter nor my compensation from Cornerstone Research is in any way contingent or based on the content of my opinion or the outcome of this or any other matter. My work on this case is ongoing; I reserve the right to modify or supplement my opinions in the event I become aware of additional information.

III. Summary of Opinions

12. Based on my background and experience, my review of the Andrien Report, and documents and testimony I have reviewed in this matter to date, I have formed the following opinions:

13. The measures and calculations that Mr. Andrien puts forth for DVAA for the 2013–2023 period are flawed and unreliable in a number of respects, and tend to overstate the revenue and operating profitability of the set of at-issue products and thus, to the extent these measures are relevant in assessing the benefits Google received from its allegedly deceptive conduct, will tend to overstate those benefits:

a. Mr. Andrien fails to acknowledge that the internal DVAA P&Ls he relies on as the basis for his measures of financial performance include revenue and

operating profit for certain DVAA products that I understand are not at issue in this matter. As a result, the measures of financial performance, including revenue and operating profit, that he puts forth tend to overstate revenue and operating profit for the set of DVAA products I understand as being relevant in this matter.

b. Mr. Andrien fails to acknowledge that allocations of certain indirect costs are, in many cases, not reflected (or not fully reflected) in various internal DVAA P&Ls, including those he relies on, which results in measures of operating profitability for DVAA that are overstated relative to those that would be obtained in P&Ls that reflect all relevant costs of the business.

c. Mr. Andrien fails to use actual 2022 revenue and operating profit and instead uses an internal DVAA P&L for fiscal year 2022 that comprises nine months of actual results and three months of forecast results. Mr. Andrien uses these same 2022 internal DVAA P&L numbers for fiscal year 2023, rather than using actual revenue and operating profit for that year. It is not clear why Mr. Andrien relies on forecast numbers or numbers from prior fiscal years when actuals are available, nor does he acknowledge that this choice results in overstated measures of DVAA operating profit for fiscal years 2022 and 2023.

14. Mr. Andrien makes a number of assertions regarding the financial performance of Alphabet and Google's advertising business to support his conclusions about the appropriate civil penalty the trier of fact should impose in the event it finds Google liable for the deceptive trade practices alleged by Plaintiffs. Specifically, Mr. Andrien indicates that his analysis of Alphabet and Google's financial performance is relevant to informing "the amount necessary to deter Google's misconduct and its ability to pay" a civil penalty.[3] Mr. Andrien's analyses of Alphabet and Google's financial performance are flawed in the following respects:

a. Mr. Andrien puts forth a set of financial metrics and measures that are not limited to Google's DVAA business but instead relate to the financial performance of Alphabet and Google as a whole. As a result, Mr. Andrien's purported analysis of the financial performance of Alphabet and Google does not relate to the products within DVAA that are at issue in this matter.

[3] Andrien Report, ¶ 77.

b. Mr. Andrien fails to provide any definition or basis for his opinion that Alphabet's financial performance has been "extraordinary" or why this opinion, even if supported, has any connection to the financial performance of Google's DVAA business.[4] At least in part, the basis for this opinion appears to rest on a purported comparison to the average financial performance of the set of public companies in the S&P500 and Nasdaq Composite indices; Mr. Andrien fails to explain why these companies, which span a variety of sectors, are a relevant or otherwise useful benchmark for Alphabet.

15. Mr. Andrien concludes his report by claiming that if a hypothetical $29 billion penalty were imposed on Google it "would not be so burdensome as to impact the day-to-day operations of the company."[5] Mr. Andrien's analysis is flawed for the following reasons:

a. Mr. Andrien's analysis does not appear to be based on any well-defined, supported methodology, nor does he define or explain "day-to-day operations" which in my experience is not a defined term in accounting, financial analysis, or financial economics. As a result, the basis for his conclusion that a $29 billion penalty "would not… impact the day-to-day operations" of Google cannot be tested because it is not defined in any economically meaningful way.

b. Mr. Andrien's analysis fails to consider the magnitude of his proposed penalty relative to the past profitability of Google's DVAA business and specifically that portion of the DVAA business that relates to the set of at-issue products.

c. Mr. Andrien's analysis appears to ignore certain adverse consequences the proposed penalty could have on Alphabet's shareholders, business, competitive position, and ability to innovate.

IV. Background on Alphabet Inc. and Google's Ad Tech Business

16. Google was founded as an online search business in 1998.[6] The company went public in 2004 and operated as a single segment entity until 2015, when Alphabet Inc. ("Alphabet" or

[4] Andrien Report, ¶ 11.
[5] Andrien Report, ¶ 131.
[6] Google, "From the Garage to the Googleplex," available at https://about.google/our-story/, accessed on July 23, 2024; Alphabet Inc. Form 10-K for the fiscal year ended December 31, 2023 ("Alphabet 2023 10-K"), p. 4 ("Our mission to organize the world's information and make it universally accessible and useful is as relevant today as it was when we were founded in 1998. Since then, we have evolved from a company that helps people find answers to a company that also helps people get things done.").

the "Company"), a public holding company, was formed.[7] Alphabet is a collection of businesses, the largest of which is Google.[8] From 2015 to 2019, Alphabet reported two segments for purposes of external financial reporting, Google and Other Bets.[9] DVAA was part of Google, which included "products such as ads, Android, Chrome, hardware, Google Cloud, Google Maps, Google Play, Search, and YouTube."[10] Other Bets is "a combination of multiple operating segments that are not individually material."[11]

17. In 2020, Google was divided into two reportable segments: Google Services and Google Cloud.[12] Google's advertising businesses are part of Google Services, which includes "ads, Android, Chrome, devices, Google Maps, Google Play, Search, and YouTube."[13] Google Cloud comprises Google's "infrastructure and platform services, collaboration tools, and other services for enterprise customers."[14]

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[7] *See, e.g.*, Google Inc. Form 424B4, August 18, 2004; Google Inc. Form 10-K for the fiscal year ended December 31, 2014, p. 79 ("[W]e operate as a single operating segment."). In August 2015, Google announced plans to create a new public holding company called Alphabet, and together Google and Alphabet Inc. filed a 10-K for 2015. *See* Alphabet Inc. and Google Inc. Form 10-K for the fiscal year ended December 31, 2015 ("Alphabet and Google 2015 10-K"), p. 2 ("[W]e announced plans in August 2015 to create a new public holding company, called Alphabet.").

[8] Alphabet and Google 2015 10-K, p. 2; Alphabet 2023 10-K, p. 4.

[9] *See, e.g.*, Alphabet Inc. Form 10-K for the fiscal year ended December 31, 2016 ("Alphabet 2016 10-K"), p. 3 ("Alphabet is a collection of businesses -- the largest of which, of course, is Google. It also includes businesses that are generally pretty far afield of our main Internet products such as Access, Calico, CapitalG, GV, Nest, Verily, Waymo, and X. We report all non-Google businesses collectively as Other Bets."), p. 23; Alphabet Inc. Form 10-K for the fiscal year ended December 31, 2019 ("Alphabet 2019 10-K"), pp. 5, 29. *See also* Alphabet and Google 2015 10-K, p. 24; Alphabet Inc. Form 10-K for the fiscal year ended December 31, 2017 ("Alphabet 2017 10-K"), p. 27; Alphabet Inc. Form 10-K for the fiscal year ended December 31, 2018 ("Alphabet 2018 10-K"), p. 26.

[10] Alphabet 2019 10-K, p. 29; *see also* Alphabet 2018 10-K, p. 26. In 2016 and 2017, this segment also included Commerce and new efforts like virtual reality. *See* Alphabet 2016 10-K, p. 23; Alphabet 2017 10-K, p. 27. In 2015, this segment also included Commerce, Apps, and newer efforts like virtual reality. *See* Alphabet and Google 2015 10-K, p. 24.

[11] Alphabet 2019 10-K, p. 29; *see also* Alphabet 2018 10-K, p. 26; Alphabet 2017 10-K, p. 27; Alphabet 2016 10-K, p. 23; Alphabet and Google 2015 10-K, p. 24.

[12] Alphabet 2023 10-K, p. 4 ("We report Google in two segments, Google Services and Google Cloud, and all non-Google businesses collectively as Other Bets."); Alphabet Inc. Form 10-K for the fiscal year ended December 31, 2020 ("Alphabet 2020 10-K"), p. 33 ("Beginning in the fourth quarter of 2020, we report our segment results as Google Services, Google Cloud, and Other Bets"). *See also* Alphabet Inc. Form 10-K for the fiscal year ended December 31, 2022 ("Alphabet 2022 10-K"), p. 82; Alphabet Inc. Form 10-K for the fiscal year ended December 31, 2021 ("Alphabet 2021 10-K"), p. 84.

[13] Alphabet 2023 10-K, p. 86. *See also* Alphabet 2022 10-K, p. 82; Alphabet 2021 10-K, p. 84; Alphabet 2020 10-K, p. 33.

[14] Alphabet 2023 10-K, p. 86. *See also* Alphabet 2022 10-K, p. 82; Alphabet 2021 10-K, p. 84; Alphabet 2020 10-K, p. 33.

18. In addition to disclosing information about its reportable segments, Alphabet reports certain more granular information for its advertising business. I understand that Google's advertising technology ("ad tech") products are included as part of "Google Network."[15]

19. **Table 1** presents revenue and operating income for the Company's 2013–2023 fiscal years for Google Network, Google Services and Alphabet as a whole, as reported in the relevant Alphabet (and Google) Form 10-K filings (operating income is not reported for Google Network).[16] For fiscal year 2023, Google Network revenue represented approximately 10% of Alphabet's total revenue and declined from fiscal year 2022.[17] Over the 2018–2023 period, Google Network revenue grew by a compound annual growth rate ("CAGR") of approximately 9%, lower than that of Google Services and Alphabet, each of which grew in excess of 15%.[18]

[15] *See, e.g.*, Alphabet 2023 10-K, p. 31 ("Google Network, which includes revenues generated on Google Network properties participating in AdMob, AdSense, and Google Ad Manager."). Google Network includes revenue from certain products not generally considered part of Google DVAA, such as AdSense for Search. *See, e.g.*, GOOG-AT-MDL-015133962 at -3963; GOOG-AT-MDL-015133684 at -3685. *See also* Defendant Google LLC's Responses and Objections to Plaintiffs' Second Set of Interrogatories, *The State of Texas, et al. v. Google LLC,* April 8, 2024 ("Google's Responses to Plaintiffs' Second Set of Interrogatories"), p. 4 (stating that "AdSense for Content" is included in the definition but not "AdSense for Search.").

[16] Alphabet reported segment results for Google and Other Bets in its 2015–2019 Form 10-K filings and for Google Services, Google Cloud, and Other Bets in its 2020–2023 Form 10-K filings.

[17] Alphabet 2023 10-K, p. 35.

[18] Over the five-year (2018-2023) CAGRs for Google Network, Google Services, and overall Alphabet revenues were 9.4%, 15.9%, and 17.6%, respectively.

Table 1
Alphabet/Google Revenue and Operating Income, 2013–2023[1]

in millions	2013	2014	2015	2016	2017
Revenue					
Google Network	$13,650	$14,539	$15,033	$15,598	$17,616
Google Segment[2]	$55,507	$65,674	$74,544	$89,984	$110,547
Alphabet	$55,519	$66,001	$74,989	$90,272	$110,855
Operating Income					
Google Segment[2]	$16,260	$18,965	$23,319	$27,055	$32,456
Alphabet	$15,403	$16,496	$19,360	$23,716	$26,178

in millions	2018	2019	2020	2021	2022	2023
Revenue						
Google Network	$20,010	$21,547	$23,090	$31,701	$32,780	$31,312
Google Services[2]	$130,524	$151,825	$168,635	$237,529	$253,528	$272,543
Alphabet	$136,819	$161,857	$182,527	$257,637	$282,836	$307,394
Operating Income						
Google Services[2]	$43,137	$48,999	$54,606	$88,132	$82,699	$95,858
Alphabet	$27,524	$34,231	$41,224	$78,714	$74,842	$84,293

Source: Alphabet and Google 2015 10-K; Alphabet 2016 10-K; Alphabet 2017 10-K; Alphabet 2018 10-K; Alphabet 2019 10-K; Alphabet 2020 10-K; Alphabet 2021 10-K; Alphabet 2022 10-K; Alphabet 2023 10-K

Note:
[1] This table contains data for each fiscal year drawn from the most recent Form 10-K filing that reported segment-level data (e.g., data for 2021 drawn from 2023 10-K). Revenue and operating income as reported in Alphabet Form 10-K filings. Alphabet does not report operating income for Google Network.
[2] Table reports data for the Google segment for 2013–2017 and for the Google Services segment for 2018–2023. Alphabet reported the relevant numbers for the Google and Other Bets segments in its 2015–2019 Form 10-K filings and for the Google Services, Google Cloud, and Other Bets segments in its 2020–2023 Form 10-K filings.

20. I understand that Google's ad tech business encompasses products and services that facilitate advertising transactions between advertisers (including advertising agencies) and publishers of digital content.[19] Advertisers (or advertising agencies) that purchase or bid on advertising space do so directly and/or through ad buying tools, including but not limited to

[19] Publishers of online content create content for, or own, digital property. This includes a variety of individuals and entities, from those who write blogs to shopping sites to online news sources to game creators. *See, e.g.*, GOOG-AT-MDL-008930806 at -0808 ("The publisher is a supplier who owns websites or mobile applications ('app') with ad inventory for sale."). Websites and apps can be programmed to create slots where ads are displayed. *See, e.g.*, Mykola Kryvtsun, "In-App Playbook: How to Get the Most Out of Advertising in Apps?" *Admixer*, May 24, 2021, available at https://blog.admixer.com/admixer-guide-app-advertising/, accessed on July 23, 2024 ("App developers set up ad slots across their interface and get revenue from impressions."); Google, "How AdSense Works," available at https://support.google.com/adsense/answer/6242051, accessed on July 23, 2024 ("You make your ad spaces available by pasting ad code on your site, and choose where you want the ads to appear. Advertisers bid to show in your ad spaces in a real-time auction. The highest paying ads show on your site.").

demand side platforms ("DSPs").[20] Publishers may use software tools, including ad exchanges/supply side platforms ("SSPs") and publisher ad servers to sell advertising space ("ad inventory") on their websites or apps.[21]

21. Based on internal documents and as I further describe below, I understand that Google prepares internal profit and loss statements (P&Ls) in various forms for internal decision-making purposes. As of fiscal year 2024, Google prepares internal P&Ls for DVAA as well as for six DVAA products: Google Ad Manager, AdSense, AdMob, Google Ads, Display and Video 360 ("DV360"), and Campaign Manager 360 ("CM360").[22]

22. I understand that Plaintiffs' remaining claims in this matter focus on certain DVAA products; specifically, Google Ad Manager (including certain functions that had been performed by AdX and DFP), Google Ads, and DV360.[23] I further understand that certain of the revenues and profits attributable to these products relate to transactions involving in-app ads, which I understand Plaintiffs do not consider to occur in the relevant markets.[24]

[20] Thad Baker, "What is Google Display & Video 360?" *Merkle Cardinal Path*, April 28, 2021, available at https://www.cardinalpath.com/blog/what-is-google-display-video-360, accessed on July 23, 2024 ("DV360 is Google's own demand side platform. A DSP is a technology platform used to buy and run programmatic advertising."); GOOG-AT-MDL-001950473 at -0480 ("Ultimate customer is the marketer/ advertiser, whose job is to reach their target audience in the most efficient way possible, given their constraints (budget, targeting, etc)."); Sissie Hsaio, "How Our Display Buying Platforms Share Revenue with Publishers," *Google,* June 23, 2020, available at https://blog.google/products/admanager/display-buying-share-revenue-publishers/, accessed on July 23, 2024 ("Google also works with large brands and their agencies to help them execute complex display advertising strategies and campaigns. These advertisers often use our Display & Video 360 enterprise software to reach consumers around the world.").

[21] IAB Australia, "Executive Briefing: Advertising Technology Purchase Guidelines," March 2018, available at https://iabaustralia.com.au/wp-content/uploads/2018/02/Ad-Tech-Purchase-Guidelines_March-2018.pdf, accessed on July 23, 2024, p. 3 ("Sell-Side Platform (SSP) … Software used by publishers to aggregate, consolidate, and manage available demand sources and exchange inventory. Sometimes includes ad serving functionality."), p. 18 ("Ad Servers are technology that serve, track, report and optimise online ads for brands and digital publishers."); Google, "What is Inventory?" available at https://support.google.com/admanager/answer/10064557?hl=en, accessed on July 23, 2024.

[22] *See, e.g.*, GOOG-AT-MDL-C-000018256. I understand that the latest produced internal financials only include information for AdSense for Content and not for other AdSense products. *See, e.g.*, GOOG-AT-MDL-019564626 at -4627–4629 ("Google will provide the following information, on a worldwide basis, for the years 2021 and 2022, separately for Google Ad Manager, AdSense for Content, Google Ads (limited to display advertising), and DV360. … In addition to the years 2021 and 2022, Google has provided financial data (booked revenue, net revenue, gross margin, and operating profit) by product (including Google Ad Manager, AdSense for Content, DV360, and Google Ads (limited to Display Network)) for the year 2020"); GOOG-AT-MDL-019564516 at -4523 ("Display P&L - 2023 V8 contains information responsive to Interrogatory 14 for the entire 2020-2022 time period on an annual basis, including support for the information included in Exhibit B of Google's Amended Supplemental Response to Interrogatory 3.").

[23] Fourth Amended Complaint*, In Re: Google Digital Advertising Antitrust Litigation,* May 5, 2023 ("Complaint"), ¶ 17; Opinion and Order re Motion to Dismiss, *In Re: Google Digital Advertising Antitrust Litigation*, September 13, 2022, pp. 30–34.

[24] Complaint, Section VI.

V. Background on Financial Reports and Accounting Data

23. Accounting systems record, measure, and summarize the economic effects of transactions and events on an entity during a given period, typically through financial reports that take various forms. These reports are used both internally and to prepare financial statements as part of the formal external reporting process.

24. The financial statements that companies report externally are intended to provide consistent, reliable, and relevant information to external constituents such as equity market investors (including current shareholders) and creditors.[25]

25. U.S. GAAP consists of a body of generally accepted accounting principles and procedures ("standards") developed and promulgated by an independent, private-sector standard setter as well as related rules and interpretative releases of the SEC.[26] All public companies file annual and quarterly reports with the SEC (i.e., Forms 10-K and 10-Q). These reports must include financial statements prepared in accordance with U.S. GAAP.[27] The SEC requires that the financial statements in annual reports of public companies are audited by independent, external auditors.[28]

[25] Srikant M. Datar and Madhav V. Rajan, *Horngren's Cost Accounting: A Managerial Emphasis*, Sixteenth Edition (Hoboken, NJ: Pearson, 2018) ("Horngren's Cost Accounting"), p. 3.

[26] The Financial Accounting Standards Board ("FASB") is the independent, private-sector, not-for-profit organization that establishes financial accounting and reporting standards for public companies that are referred to as Generally Accepted Accounting Principles, "U.S. GAAP" or simply "GAAP." The FASB is recognized by the SEC as the designated accounting standard setter for public companies. *See, e.g.*, Financial Accounting Standards Board, "About the FASB," available at https://www.fasb.org/facts, accessed on July 23, 2024. The FASB Accounting Standards Codification ("ASC") is the source of authoritative GAAP recognized by the FASB for public companies. *See* Financial Accounting Standards Board, "105-10-05: Overview and Background," available at https://asc.fasb.org/1943274/2147479442, accessed on July 23, 2024 ("This Topic establishes the *Financial Accounting Standards Board (FASB) Accounting Standards Codification*® (Codification) as the source of authoritative generally accepted accounting principles (GAAP) recognized by the FASB to be applied by nongovernmental entities. Rules and interpretive releases of the Securities and Exchange Commission (SEC) under authority of federal securities laws are also sources of authoritative GAAP for SEC registrants. In addition to the SEC's rules and interpretive releases, the SEC staff issues Staff Accounting Bulletins that represent practices followed by the staff in administering SEC disclosure requirements, and it utilizes SEC Staff Announcements and Observer comments made at Emerging Issues Task Force meetings to publicly announce its views on certain accounting issues for SEC registrants.").

[27] United States Securities and Exchange Commission, "Exchange Act Reporting and Registration," June 24, 2024, available at https://www.sec.gov/resources-small-businesses/going-public/exchange-act-reporting-registration, accessed on July 24, 2024; United States Securities and Exchange Commission, "Financial Reporting Manual: Topic 1 – Registrant's Financial Statements," November 18, 2020, available at https://www.sec.gov/corpfin/cf-manual/topic-1, accessed on July 24, 2024.

[28] United States Securities and Exchange Commission, "All About Auditors: What Investors Need to Know," June 24, 2002, available at https://www.sec.gov/about/reports-publications/investorpubsaboutauditorshtm, accessed on July 24, 2024; United States Securities and Exchange Commission, "Financial Reporting Manual: Topic 1 – Registrant's Financial Statements," November 18, 2020, available at https://www.sec.gov/corpfin/cf-manual/topic-1, accessed on July 24, 2024.

26. Internal financial reports serve a variety of management and business purposes, often at different levels of the organization.[29] Managers adapt internal reports to provide financial or non-financial information most relevant to the purposes of the company or its managers (including those at different levels of the organization). These internal reports do not have to conform to U.S. GAAP.[30]

27. Aggregating, organizing, and analyzing cost information requires an understanding of the nature of the economic resources consumed by the organization. To analyze, manage, and/or report information relevant for decisions, management may assign or allocate costs to "cost objects" such as businesses, products and services, or activities, depending on purpose.[31]

28. Costs can be classified as either direct or indirect costs. Direct costs are those that can be directly traced to a cost object, such as a specific division, activity, process, product, or service.[32] In a manufacturing organization, direct costs typically include the costs of materials that go into a product and the cost of labor used to assemble the product. Indirect costs are those that cannot be directly traced to a business or product. The salaries of centralized, administrative personnel (e.g., payroll department employees) are usually indirect costs. If relevant and useful for some decision, indirect costs may be allocated to the relevant cost object using an allocation rule or mechanism.[33] The allocation of indirect costs is often complex and challenging, especially for entities that have multiple, inter-connected and related products and businesses.[34] Companies may allocate indirect costs to individual cost objects in different ways, depending on what drives the costs and the purpose of the analysis, or they may choose not to allocate indirect costs at all.

29. An important consideration in preparing internal accounting and financial reports is the identification of which information (including cost information) is relevant and useful for the purpose at hand; different purposes call for different information.[35] Cost-benefit considerations are also relevant in determining how internal reports are prepared. For example, organizations may choose not to allocate certain indirect costs to different products or business units if the costs of such allocations exceed the benefits.[36] Similarly, it is not uncommon for entities *not* to allocate certain indirect costs to products or businesses,

[29] Horngren's Cost Accounting, pp. 2–3.
[30] Horngren's Cost Accounting, pp. 2–3.
[31] Horngren's Cost Accounting, p. 29.
[32] Horngren's Cost Accounting, p. 29.
[33] Horngren's Cost Accounting, pp. 29–30.
[34] Horngren's Cost Accounting, pp. 30–31.
[35] Horngren's Cost Accounting, p. 13.
[36] Horngren's Cost Accounting, pp. 2–3, 655.

depending on the nature of the costs and purpose of the analysis.[37] It is also not uncommon for entities to prepare different P&Ls or different versions of P&Ls (with different revenue or cost data) for a given product or division for different internal purposes. For similar reasons, how internal P&Ls are prepared may change over time as businesses (and how those businesses are managed and organized) change and evolve.

VI. Internal Management Reporting at Google

30. Alphabet (and Google) prepare a variety of internal accounting and financial reports at different levels of the organization for a variety of business and management purposes. Alphabet's accounting policies indicate that internal P&Ls provide "results and metrics that management uses to make business decisions, allocate resources, and gain insight into the overall health of the business."[38]

31. Google prepares internal P&Ls for various product areas within Google Services. As I explain further below, Google prepares internal P&Ls for internal purposes, including for business and management decisions.[39] The preparation, format, and use of these internal P&Ls has naturally evolved and expanded over time to reflect how Google's business has changed—as products emerge and mature, the need for P&Ls and other financial data grows. The accounting estimates and methods used to prepare these P&Ls evolve and change for similar reasons. In recent years, Google has prepared P&Ls for different ads-related product areas, sometimes referred to as "Go/Ads" P&Ls, which, as of fiscal year 2024, include P&Ls for the

[37] Horngren's Cost Accounting, p. 655.

[38] GOOG-AT-MDL-008930610 at -0619 ("Internal income statements are presented in a way that focuses on the results and metrics that management uses to make business decisions, allocate resources, and gain insight into the overall health of the business. Internal operating results are also used by decision makers (including the Chief Operating Decision Maker) to evaluate the performance of reportable segments").

[39] In addition, Google prepares "external view" P&Ls that differ from internal P&Ls in certain respects (with respect to, for example, certain cost classifications). I understand that the "external view" P&Ls largely align with how Alphabet reports in its external financial statements (i.e., in conformity with U.S. GAAP). *See, e.g.*, Mok Deposition, p. 21:10–14 ("There are two standard P&L views… Q What are those? A One which we call the external view, and then one which we call the management view."), p. 100:12–13 ("A It has both an external view and a management view."), p. 21:16–19 ("A The external view treats -- the management view has a bucket of costs that we internally consider OpEx. The external view treats this pool of cost as cost of sales."), p. 157:22–24 ("A The ads P&L has the two views we talked about, one which aligns to external reporting and one which aligns to management reporting.").

Search and Search Ads (presented as Search+), DVAA, YouTube, and Geo + Local (presented as Geo) product areas.[40]

32. Google also prepares internal P&Ls for certain products within the DVAA product area ("DVAA product-level P&Ls"), recently (starting in 2021) based on [redacted] approach.[41] As of fiscal year 2024, these P&Ls are prepared for AdSense, Google Ad Manager, AdMob, Google Ads, DV360, and CM360.[42] [redacted] was retroactively prepared for 2020.[43] I understand that Google is [redacted] DVAA product-level P&Ls prior to 2020.[44]

33. I further understand that [redacted] the Company prepared different forms of product-level P&Ls, either on an *ad hoc* basis[45] or, later, as part of an effort known as "Project Slice."[46] I understand the early product-level P&Ls were limited, particularly with respect to cost allocations, and provided a limited view of the profitability of the different products; additionally, there is limited documentation of the methodology used to create these

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[40] *See, e.g.*, GOOG-AT-MDL-C-000018044; Mok Deposition, p. 154:16–18 ("A … [T]here's a central ads team that makes a document called go/ads P&L, which is the aggregated ads P&L that's the next level up from DVAA"). Throughout this report, I refer to the "Annual Ads" P&Ls, which contain P&Ls for ads-related product areas, as "Go/Ads" P&Ls (some of the documents contain a tab explicitly labelling the P&Ls as "go/ads" or "go/adspnl," while others do not). *See, e.g.*, GOOG-AT-MDL-009709864; GOOG-AT-MDL-008927854.

[41] Google's Responses to Plaintiffs' Second Set of Interrogatories, p. 12 ("In 2021, Google developed and implemented a [redacted] view for determining the financial metrics for Google Ad Tech Products, which Google subsequently applied to 2020 product-level data in the ordinary course. A [redacted]."). Throughout this report, I refer to DVAA product-level P&Ls and "management view" P&Ls in "Go/Ads" P&Ls as "internal DVAA P&Ls."

[42] *See, e.g.*, GOOG-AT-MDL-C-000018256.

[43] Mok Deposition, p. 81:17–21 ("Q And when was the shift? A We started laying the groundwork for this in … early 2021 time frame. Q And when was it implemented? A Sometime in 2021."); Google's Responses to Plaintiffs' Second Set of Interrogatories, p. 12.

[44] Google's Responses to Plaintiffs' Second Set of Interrogatories, p. 12 ("Prior to [redacted] costs and revenue were allocated to these [DVAA] products based on a buyside or sellside view rather than the specific product. Google is limited in its ability to retroactively apply the current methodology, as the data used by the current methodology may not be available for earlier years, and the assumptions supporting the methodology may not be appropriate in light of the many changes to Google's business over fifteen years. As a result, Google cannot provide MECE financial metrics for the 2007-2019 period.").

[45] *See, e.g.*, GOOG-AT-MDL-004039971. *See also* Google's Responses to Plaintiffs' Second Set of Interrogatories, p. 14 ("Current Google Finance personnel are unaware of a centralized effort to examine or create product-level P&Ls prior to 2017 but … certain pre-2017 ad hoc documents contain some information on product-level profits.").

[46] Mok Deposition, p. 126:22–24 ("Project Slice was our project name for taking the aggregate DVAA P&L and trying to slice it more granularly"); Google's Responses to Plaintiffs' Second Set of Interrogatories, p. 14 ("These documents relate to a Google effort between 2017 to 2019, known as 'Project Slice,' to begin to develop profit and loss statements at the product level for certain Google Ad Tech Products.").

P&Ls.[47] I further understand that more recent "Project Slice" P&Ls "were based on imperfect approximations of how revenue, profit, and/or cost could be allocated across products."[48] As noted below and is generally true, changes in the preparation of product-level P&Ls reflect the evolution of the business and the products over time as the business grew and matured.

34. Internal DVAA P&Ls typically include certain direct costs and allocated indirect costs; [redacted].[49] Internal DVAA P&Ls typically report line item detail, which allows different users to make adjustments and prepare specific profitability measures that best suit their purposes. Various methods are used to [redacted].[50] The methods used to allocate costs to product areas and products changed over time to reflect changes in the underlying businesses, products, and how they are organized and managed, as well as to improve the quality of the allocations (e.g., in attempts to better reflect the underlying cost drivers as well as ownership of the relevant costs).[51] I understand that, at least for some period, certain DVAA product-level P&Ls were prepared monthly and included

[47] *See, e.g.*, GOOG-DOJ-AT-02645470 at -5472 ("We have a preliminary view of the profitability by each buyside product, but it's being refined"); GOOG-AT-MDL-004021793 at -1796 ("Product level allocations need continued tweaking ([redacted]"); GOOG-DOJ-AT-02642407 at p. 5 ("Resource allocation across buyside products (e.g. Eng/PM HC) could be improved"). *See also* GOOG-AT-MDL-019564626 at -4632 ("[T]here are documents in Google's productions containing product-level financial metrics pre-2018… Google has not been able to identify current Google Finance personnel with first-hand knowledge of these documents or otherwise identify the process and methodology used in preparing these documents.").

[48] Google's Responses to Plaintiffs' Second Set of Interrogatories, p. 13.

[49] Accountants recognize costs as expenses (on the P&L) when the associated economic resources are consumed (e.g., the cost associated with long-lived assets such as buildings and equipment is recognized as depreciation expense periodically over the useful life of the asset).

[50] GOOG-AT-MDL-009017857 at -7871–7872; GOOG-AT-MDL-009709671 at -9675 ("[redacted]). *See also* Mok Deposition, p. 52:12–20 ("Machines, resources, and costs are managed by different engineers in -- in groups of services we call anchors. The anchors -- some of the anchors are dedicated to certain products and businesses, and the dedicated ones get attributed to those P&Ls. The majority of the anchors are shared services across products, and the -- the managers of those anchors work with the engineering leaders in the products to propose and vet and agree on the cost allocation of those anchors.").

[51] *See, e.g.*, GOOG-AT-MDL-009068311 at -8314 ("Summary of Approved Changes (2020+)"); GOOG-DOJ-AT-02643272 at pp. 6–7 ("Allocation Change Details … Allocations Going Forward"); GOOG-DOJ-06206871 at -6881. *See also* Mok Deposition, p. 78:9–15 ("Q And what drove the change in 2019? A Same as I said, that allocation changes are driven by we want to have better allocation -- better allocations that are -- it's more clear what's driving the cost is one factor, and then the other one is trying to balance that against a really simple, clear allocation methodology.").

actuals for the prior months (of a given fiscal year) and forecasts for the remaining months (of the fiscal year).[52]

35. As with many organizations, Google's internal P&Ls are created and used for a variety of purposes. As Jessica Mok, the former finance director for DVAA,[53] explained, internal DVAA P&Ls are prepared to provide senior leaders in the display business with "visibility into the [DVAA] business economics" to inform their business decisions.[54]

36. Because internal DVAA P&Ls are primarily used for internal decisions, they do not (and are not designed) to [redacted] to operate and manage the relevant business or product. As I discuss below, while the internal DVAA P&Ls I have reviewed include certain [redacted].[55]

VII. Summary of Mr. Andrien's Financial Analyses

37. I understand that Mr. Andrien was asked to "analyze certain factors that [he] understand(s) are relevant to determining the applicable statutory penalties" that Plaintiffs are seeking in this matter "under each State's deceptive trade practices statutes."[56] I further understand that Mr. Andrien does not address Plaintiffs' antitrust claims.[57]

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[52] *See, e.g.*, GOOG-AT-MDL-001056062 at -6062 ("The DVAA P&L is run monthly following each financial forecast cycle (V3, V8, etc.). Each V number reflects the month in which the forecast was completed and includes YTD actuals for n-1 and a financial forecast for the remainder of the year."). *See also* Mok Deposition, p. 30:8–10 ("Each number reflects the month in which -- that it was produced; so the first number, V5, is Version 5, May of that year.").

[53] Mok Deposition, p. 12:19–25 ("Q … what was your last role at -- in this display ads business? A I was the finance director for display ads. Q And that was between what time? A November 2021 until I left the role in August 2023."). I understand that Mok now has the same role for Google's Maps business. *See* Mok Deposition, pp. 11:19–12:5 ("Q What is your position? A I'm a finance director. … Q What business units do you oversee? A Currently, Google Maps. I -- prior to that, at -- before August 2023, I worked on the display ads business.").

[54] Mok Deposition, pp. 24:4–25:2 ("Q Who were these P&Ls sent to? A Generally, senior leaders in the display business, primarily product and engineering leadership. … A The -- I would say my team produced P&Ls for visibility into the business economics -- for senior leaders to have visibility into the business economics. … At times, the visibility was an input to their business decision."). *See also* GOOG-AT-MDL-002182530; GOOG-DOJ-11916795, showing data from the internal DVAA P&Ls being shared with senior leadership.

[55] As aforementioned, cost allocation methods changed over time and, as a result, the extent to which [redacted] are not reflected in internal DVAA P&Ls changed over time. For example, as I explain below, [redacted] *See, e.g.*, GOOG-AT-MDL-003206332 at -6335–6336 ("[redacted]").

[56] Andrien Report, ¶ 7.

[57] Andrien Report, ¶ 7, note 4 ("The Plaintiff States have also brought antitrust claims against Google in this matter; however, my opinions are limited to those claims related to deceptive trade practices.").

38. Mr. Andrien offers certain analyses and measures that, in his view, are relevant to assessing the financial performance of Alphabet, Google's advertising business, and Google's display advertising business for the 2013–2023 period, and opines that these analyses "establish[] Google as [a] highly profitable and successful company during the relevant period and inform[] the amount necessary to deter Google's misconduct and its ability to pay" a civil penalty.[58]

39. Mr. Andrien puts forth estimates of DVAA revenue and profit attributable to each of the Plaintiff States and in total for these states (his Table 1).[59] Mr. Andrien first relies on certain internal DVAA P&Ls to measure revenue and operating profit for specific DVAA products.[60] He then uses those amounts to estimate the revenue and operating profit for the U.S. portion of the Company's business, based on what Alphabet reports for revenue in each geographic region, including the U.S., in Form 10-K filings.[61] He then allocates these amounts to the Plaintiff States by applying the fraction of internet subscribers in each of these states to the total number of internet subscribers in the U.S. (using American Community Survey ("ACS") data).[62] Based on these calculations, Mr. Andrien's Table 1 purports to represent the total revenue and operating profit for what he calls Display Advertising for the Plaintiff States in each year from 2013 through 2023.[63]

40. In addition, Mr. Andrien summarizes certain financial measures that Alphabet reports in its financial statements, including revenue, operating income and operating margin, net income and net income margin; reported balance sheet numbers for cash, cash equivalents,

[58] Andrien Report, ¶ 77.

[59] Andrien Report, ¶ 94–95, Table 1.

[60] Andrien Report, ¶ 92. Mr. Andrien includes revenue and operating profit from P&Ls for the following products: AdSense for Content, AdX, DoubleClick Bid Manager, AdMob, DoubleClick for Publishers, AdServing, Ad Manager, AwBid, Display & Video 360, Campaign Manager, and Google Ads. For 2023 Mr. Andrien uses the revenue and operating profit numbers for 2022 ostensibly because the P&Ls available to him in production did not include data for 2023 for the products in his analysis. *See* Andrien Report, ¶ 92.

[61] Andrien Report, ¶ 93. I understand that Mr. Andrien calculates these estimates by multiplying his measures of revenue and operating profit for the different DVAA products by the fraction of Alphabet's worldwide revenue attributable to the U.S. in each year. *See* Andrien Report, ¶ 93.

[62] Andrien Report, ¶ 94. I understand that Mr. Andrien narrows his estimates to the Plaintiff States by multiplying the revenue and operating profit measures specific to the U.S. from the prior step by his estimated ratios for each of the Plaintiff States (Mr. Andrien estimates the number of internet subscribers in each state by multiplying the share of each state's households that have an internet subscription, as provided by the ACS, by the population of the state, which he then uses to estimate, for each Plaintiff State, the ratio of people in the state with an internet subscription to the total number of internet subscribers for the U.S. as a whole). For 2023, Mr. Andrien uses the same ratio he estimates for 2022, as the U.S. Census Bureau has not yet released 2023 ACS data. *See* Andrien Report, ¶ 94.

[63] Andrien Report, ¶ 95, Table 1.

and short-term marketable securities; along with stock price and market capitalization at certain points in time.[64]

41. Specifically, Mr. Andrien presents Alphabet company-wide reported revenue, operating income, and net income for its 2013–2023 fiscal years, as well as growth rates (CAGRs) for these measures over this period, and in some cases totals for these numbers aggregated across this period.[65] He also presents year-end balances for Alphabet's cash, cash equivalents, and short-term marketable securities as of its 2013–2023 fiscal year-ends (as well as for the quarter ended March 31, 2024), along with the simple growth rate for these amounts over the same period.[66]

42. Mr. Andrien purports to compare Alphabet's financial performance and growth to that of other companies. He compares the performance of Alphabet's stock to that of the S&P 500 and Nasdaq Composite, stating that Alphabet's stock price growth for the January 2, 2013 to June 3, 2024 period was "3.28 times the growth of the S&P 500 and 1.95 times the growth of the Nasdaq Composite over the same period."[67] He notes that Alphabet "is the fourth largest company by market capitalization in the world" and that its market capitalization exceeds that of certain other companies combined.[68]

43. Mr. Andrien also presents certain financial metrics for Google's advertising business as a whole, which, as I explain below, are predominantly attributable to products not part of DVAA.[69] Mr. Andrien reports Google's advertising revenue, the ratio of advertising revenue to revenue for the Company as a whole, an estimate of the operating profit Google earns from advertising, and an estimate of the ratio of Google's operating profit from advertising to Alphabet's overall operating profit, for each year from 2013–2023.[70] I understand that Mr. Andrien purports to estimate the operating profit for Google's advertising business overall (including Search) in each year by multiplying Google's total advertising revenue by the operating margin the Company reports for the Google segment (for 2013–2017) and for the Google Service segment (for 2018–2023).[71]

[64] Andrien Report, § IV.A. Stock price and market capitalization data are not usually reported in financial statements and are, I understand, obtained from separate sources. Mr. Andrien sometimes aggregates the Company's cash and cash equivalents with its marketable securities; I note that the Company reports these separately in its financial statements. *See, e.g.,* Alphabet 2023 10-K, p. 51.
[65] Andrien Report, ¶ 78–80, Charts 1–3.
[66] Andrien Report, ¶ 81, Chart 4.
[67] Andrien Report, ¶ 83.
[68] Andrien Report, ¶ 84–85.
[69] Andrien Report, ¶ 86–90.
[70] Andrien Report, ¶ 86–90, Charts 8–10.
[71] Andrien Report, ¶ 87.

44. Finally, Mr. Andrien presents a series of financial ratios and metrics he claims are relevant to assessing the "effect" on Google's profitability, financial position, liquidity, and cash flow if Google were to pay a civil penalty of $29.08 billion. He claims that the effect of paying this penalty "would not be so burdensome as to impact the day-to-day operations of the company or bankrupt Google."[72] In regards to profitability, Mr. Andrien presents the purported effect on Alphabet's EBIT and EBIT margin, EBITDA and EBITDA margin, net income and net income margin, and earnings per share for fiscal year 2023, had the proposed penalty been imposed and paid in this period.[73] In regards to the effect on financial position and liquidity, Mr. Andrien presents the purported change in Alphabet's cash and cash equivalents, current assets, total assets, current ratio (i.e., current assets divided by current liabilities), and cash ratio (i.e., cash and cash equivalents divided by current liabilities) as of March 31, 2024, assuming the proposed penalty had been imposed and paid on that date.[74] Mr. Andrien acknowledges that his proposed penalty exceeds Alphabet's entire balance of cash and cash equivalents but nevertheless opines that the penalty "would not cause Google any operational challenges, liquidity needs, or solvency concerns" because, according to him, the fact that Alphabet's board recently authorized a $70 billion share repurchase "indicates that Google has already determined that it can continue operating even with a $70 billion reduction in its current assets."[75] Lastly, Mr. Andrien presents the purported change in Alphabet's operating cash flow for fiscal year 2023, assuming payment of the proposed penalty during that period.[76]

VIII. Mr. Andrien's Analyses of the Financial Performance of Google's DVAA Business Are Flawed and Unreliable

45. As described above, Mr. Andrien presents an analysis of the financial performance of DVAA to purportedly estimate revenue and operating profit generated by DVAA in the Plaintiff States.

46. Mr. Andrien opines that DVAA operating profit is an "inadequate and inappropriate proxy for the overall benefit, both direct and indirect, that Google has gained from the

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[72] Andrien Report, ¶ 131.
[73] Andrien Report, ¶ 134, Table 5.
[74] Andrien Report, ¶ 138, Table 6.
[75] Andrien Report, ¶ 139.
[76] Andrien Report, ¶ 140, Table 7.

misconduct"[77] and instead "consider(s)" DVAA revenue in "assessing the total penalty necessary to eliminate Google's financial incentive to engage in the alleged misconduct."[78] At least in part, Mr. Andrien's basis for this appears to be his view that the operating profit of DVAA "does not measure the totality of Google's benefit from its misconduct nor its ability to leverage its gains from this misconduct."[79] He also asserts that "Google's past operating profit in the display advertising segment ignores the future gains that Google stands to make by virtue of its misconduct to date"[80] and appears to suggest that TAC should not be considered as a cost in calculating such benefits.[81]

47. As an initial matter, to the extent Mr. Andrien is claiming that measures of operating profitability are relevant in assessing these benefits, it is inappropriate to use measures of profitability that do not include *all* relevant costs that benefit the business. It is also unclear why projected future operating profits would be relevant to this assessment.

48. More generally, Mr. Andrien does not explain why operating profit is the appropriate accounting measure to assess any "overall benefit" to Google. When measuring the benefits that a company receives or "earns" from an economic activity, accountants and financial analysts typically use an entity's (bottom-line) net income, which reflects all of the relevant costs including income taxes, interest, and other non-operating items.[82] As a result, an entity's net income (or "earnings"), including as reported under U.S. GAAP, is usually lower than its operating income (or profit).[83] As such, Mr. Andrien's reliance on measures of DVAA operating profit to purportedly measure the benefits enjoyed by Google is inappropriate because these numbers do not reflect what DVAA and Google "earn" from the relevant economic activities and will tend to overstate such amounts. As **Table 2** shows, the net income reported by Alphabet in its Form 10-K filings is usually lower than the reported operating income.

[77] Andrien Report, ¶ 123.
[78] Andrien Report, ¶ 123.
[79] Andrien Report, ¶ 119.
[80] Andrien Report, ¶ 122.
[81] Andrien Report, ¶ 120 ("Google's ability to make these payments is key to their ability to continue to dominate the display ads ecosystem. This should be considered when accounting for the benefit Google has gained from its display advertising misconduct.").
[82] *See, e.g.,* Joshua Rosenbaum and Joshua Pearl, *Investment Banking: Valuation, Leveraged Buyouts, and Mergers & Acquisitions*, Second Edition (Hoboken, NJ: John Wiley & Sons, Inc., 2013), p. 37. *See also* Alphabet 2023 10-K, pp. 52, 76. Non-operating items include gains and losses as well as non-operating expenses.
[83] For example, Alphabet 2023 10-K reports operating income of $84.3 billion and net income of $73.8 billion, with the difference largely due to a $11.9 billion income tax expense. *See* Alphabet 2023 10-K, p. 52.

Table 2
Alphabet/Google: Operating Income and Net Income, 2013–2023

in millions	2013	2014	2015	2016	2017
Operating Income	$15,403	$16,496	$19,360	$23,716	$26,178
Net Income	$12,733	$14,136	$16,348	$19,478	$12,662

in millions	2018	2019	2020	2021	2022	2023
Operating Income	$27,524	$34,231	$41,224	$78,714	$74,842	$84,293
Net Income	$30,736	$34,343	$40,269	$76,033	$59,972	$73,795

Source: Alphabet and Google 2015 10-K; Alphabet 2016 10-K; Alphabet 2017 10-K; Alphabet 2018 10-K; Alphabet 2019 10-K; Alphabet 2020 10-K; Alphabet 2021 10-K; Alphabet 2022 10-K; Alphabet 2023 10-K

Note: This table contains data for each fiscal year drawn from the most recent Form 10-K filing that reported the relevant segment-level data (e.g., data for 2021 drawn from 2023 10-K). Net income and operating income as reported in Alphabet Form 10-K filings.

49. Putting aside the appropriateness and relevance of the metrics he analyzes, Mr. Andrien fails to acknowledge limitations of his measures of revenue and operating profit for DVAA. First, he fails to acknowledge that the inputs to his measures tend to overstate the relevant numbers because they include products not at issue in this matter. As noted in Section IV, I understand that certain DVAA products, such as CM360, AdMob, and AdSense, are not at issue in this matter. As such, financial results for these products should be excluded from any analysis of financial performance; because Mr. Andrien fails to do this, his measures of revenue and operating profit are overstated.

50. **Table 3** shows how Mr. Andrien's estimates of booked revenue and operating profit for fiscal years 2020–2022, reported in Exhibit 2 of his report, would change if I limit his analyses to the at-issue DVAA products, i.e., to Google Ad Manager, Google Ads, and DV360. If I use the internal DVAA P&Ls that Mr. Andrien relies on (although, as I explain below, some of his P&L choices are unsupported), **Table 3** shows that Mr. Andrien's estimates of annual DVAA revenue are consistently overstated—by [redacted] or more—for fiscal years 2020, 2021, and 2022, as a result of including DVAA products that are not at issue. Similarly, Mr. Andrien's analysis overstates annual operating profits, for example, by [redacted] in fiscal year 2020 (the operating profit for the DVAA products at issue [redacted] in fiscal year 2020) and by at least [redacted] in both fiscal years 2021 and 2022. Moreover, the revenue numbers reported here for the at-issue products are overstated in that, as I understand it, they include revenue from certain types of transactions that are not part of the allegations in this matter (i.e., in-app transactions).

Table 3
Estimates of Booked Revenue and Operating Profit Based on Mr. Andrien's Methodology
DVAA Overall vs. At-Issue DVAA Products, 2020–2022

[redacted]	[redacted]	[redacted]	[redacted]2[3]
[redacted]			
[redacted][1]	[redacted]	[redacted]	[redacted]
[redacted][2]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]			
[redacted][1]	[redacted]	[redacted]	[redacted]
[redacted][2]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]

Source: GOOG-DOJ-AT-02649870; Andrien Report

Note:
[1] Numbers are drawn from Andrien Report Exhibit 2. The DVAA product-level P&Ls used by Mr. Andrien for 2020–2022 are AdMob, AdSense, Google Ad Manager, Google Ads, DV360, and CM360.
[2] Numbers are drawn from the DVAA product-level P&Ls used by Mr. Andrien but limited to the At-Issue DVAA Products, which are Google Ad Manager, Google Ads, and DV360.
[3] The 2022 V10 P&L used by Mr. Andrien contains actuals for 9 months and forecasts for the remaining 3 months of 2022.

51. Further, Mr. Andrien fails to acknowledge or address that internal P&Ls, such as internal DVAA P&Ls, do not usually reflect all relevant costs that benefit a business and, as such, tend to overestimate operating profitability.

52. For example, I understand that certain costs necessary to support Alphabet, Google, and its constituent businesses broadly were typically not allocated to the segments and/or product areas (and so not allocated to products). [redacted][84] Based on the most recent Alphabet Form 10-K filing, these unallocated costs ("Alphabet-level activities") amounted to approximately $3.1 billion, $1.3 billion, and $9.2 billion for fiscal years 2021, 2022, and

[84] GOOG-AT-MDL-006876286 at -6289–6290 ("Corporate / Alphabet Services driven at an Alphabet level … Unallocated"); GOOG-AT-MDL-009755689 at -5701 ([redacted]."); GOOG-DOJ-AT-02645766 at -5771. *See also* Alphabet 2023 10-K, p. 86, which indicates that certain costs associated with Google DeepMind were moved from the segment level to the Alphabet level during 2023.

2023, respectively.[85] If the purpose of Mr. Andrien's analysis is to assess the profitability of Google's DVAA business, some portion of these costs would be appropriately assigned to this business. As a result, measures of operating profit that rely on internal DVAA P&Ls will tend to overstate the profitability of DVAA.

53. Further, based on my understanding of [redacted].[87] Although [redacted].[88] [redacted]

54. Mr. Andrien fails to acknowledge or account for these costs, resulting in measures of DVAA profitability that are overstated relative to those obtained from P&Ls that reflect these costs, including those prepared on a standalone basis.

55. In addition, in measuring revenue and operating profit for fiscal year 2022, Mr. Andrien relies on contemporaneous forecasts rather than actuals. Specifically, the internal DVAA P&L he relies on for fiscal year 2022 contains nine months of actual results and three months of forecast data.[90] Mr. Andrien fails to explain why he uses forecast data rather than actuals or why this is appropriate for his intended purpose, nor does he acknowledge that this choice, as shown below, results in him overstating the operating profit of DVAA for fiscal year 2022.

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[85] Alphabet 2023 10-K, p. 86. *See also* Alphabet 2023 10-K, p. 39 ("For the year ended December 31, 2023, Alphabet-level activities include charges related to the reduction in force and our office space optimization efforts totaling $3.9 billion. In addition, for the year ended December 31, 2023, we incurred $269 million in accelerated rent and accelerated depreciation.").

[86] GOOG-AT-MDL-009709671 at -0676.

[87] GOOG-AT-MDL-006876286 at -6317. *See also* Mok Deposition, p. 84:15–20 ([redacted]).

[88] GOOG-AT-MDL-003206332 at -6335–6336 ("[redacted]"). *See also* GOOG-AT-MDL-009709671 at -0676 ([redacted]

[89] *See, e.g.*, GOOG-AT-MDL-003206332 at -6337–6338.

[90] GOOG-DOJ-AT-02649870; Andrien Report, Exhibit 2; Mok Deposition, p. 30:7–10 ("Q [redacted].").

56. This choice is also important because Mr. Andrien does not use actual (or forecast) results for fiscal year 2023. Instead, he assumes the P&L numbers for fiscal year 2023 are the same as those for fiscal year 2022, a choice he deems "conservative[]."[91] In fact, I understand that DVAA booked revenue for fiscal year 2023 was approximately [redacted], [redacted] than for fiscal year 2022 and approximately [redacted] than the 2022 number assumed by Mr. Andrien.[92] Further, I understand that DVAA's operating profit for fiscal year 2023 was approximately [redacted] than that used by Mr. Andrien, which means that his measures [redacted] DVAA's operating profitability for fiscal year 2023.[93]

57. **Table 4A** presents measures of revenue and operating profit for the at-issue DVAA products based on the most recent internal DVAA P&Ls and compares them to the corresponding numbers that Mr. Andrien presents in Exhibit 2 of his report. Together, **Tables 3** and **4A** show that the choices made by Mr. Andrien—to include DVAA products not at issue and rely on the 2022 number detailed above for fiscal years 2022 and 2023—result in him presenting measures that consistently and substantially overstate the revenue and operating profit attributable to the at-issue products.[94] Specifically, Mr. Andrien's annual booked revenue numbers put forth in his Exhibit 2 [redacted]n each fiscal year during the 2020–2023 period. Similarly, Mr. Andrien's operating profit numbers [redacted] each fiscal year during the 2020–2023 period and [redacted] over the entire period. In fact, operating profit for the at-issue DVAA products [redacted]. Moreover, because Mr. Andrien relies on numbers from his Exhibit 2 to generate the revenue and operating profit purportedly attributable to the Plaintiff States in his Table 1, he also, as shown in **Table 4B,** overstates revenue and operating profit for the at-issue DVAA products in his Table 1.[95] Moreover, as previously discussed, the numbers in **Tables 4A and 4B** overstate operating profitability

[91] Andrien Report, ¶ 92.
[92] GOOG-AT-MDL-C-000018044; GOOG-AT-MDL-C-000018256; Andrien Report, Exhibit 2.
[93] GOOG-AT-MDL-C-000018256; Andrien Report, Exhibit 2.
[94] I understand that [redacted]
[95] Andrien Report, Table 1.

because the internal DVAA P&Ls do not reflect [redacted].

Table 4A
Estimates of Booked Revenue and Operating Profit
Andrien Report Exhibit 2 vs. At-Issue DVAA Products, 2020–2023

[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]					
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]					
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Source: GOOG-DOJ-AT-02649870; GOOG-AT-MDL-009643893; GOOG-AT-MDL-C-000018256; Andrien Report

Note:
[1] Numbers are drawn from Andrien Report Exhibit 2. The DVAA product-level P&Ls used by Mr. Andrien for 2020–2023 are AdMob, AdSense, Google Ad Manager, Google Ads, DV360, and CM360. The 2022 V10 P&L used by Mr. Andrien contains actuals for 9 months and forecasts for the remaining 3 months of 2022.
[2] At-Issue DVAA Products are Google Ad Manager, Google Ads, and DV360. Numbers for 2020–2022 are drawn from the 2023 V8 P&L, which contains actuals for 2020–2022. Numbers for 2023 are drawn from the 2024 V4 P&L, which contains actuals for 2023.

Table 4B
DVAA Booked Revenue and Operating Profit Attributable to Plaintiff States per Mr. Andrien's Methodology, 2020–2023

[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]					
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]					
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Source: GOOG-DOJ-AT-02649870; GOOG-AT-MDL-009643893; GOOG-AT-MDL-C-000018256; Alphabet 2022 10-K; Alphabet 2023 10-K; ACS; Andrien Report

Note:
[1] Numbers are drawn from Andrien Report Table 1. The DVAA product-level P&Ls used by Mr. Andrien for 2020–2023 are AdMob, AdSense, Google Ad Manager, Google Ads, DV360, and CM360. The 2022 V10 P&L used by Mr. Andrien contains actuals for 9 months and forecasts for the remaining 3 months of 2022.
[2] Numbers calculated by multiplying the numbers for At-Issue DVAA Products by the respective ratios that Mr. Andrien uses for each year to apportion the numbers in his Exhibit 2 to numbers purportedly attributable to the Plaintiff States as presented in the Andrien Report Table 1. [redacted]

IX. Mr. Andrien's Assertions Regarding the Financial Performance of Alphabet and Google's Advertising Business Are Flawed

58. In addition to an analysis of the financial performance of Google's DVAA business, Mr. Andrien puts forth a number of analyses of different financial measures for Alphabet overall and for Google's advertising business. Mr. Andrien appears to rely on such calculations to support certain conclusions, including that "Google's financial performance

during the period 2013 to present has been extraordinary" and that "Google's growth and profitability have been driven by advertising."[96]

59. Mr. Andrien fails to explain why his purported analysis of the financial performance of Alphabet and of Google's advertising business is relevant to his opinions. My understanding is that only certain products within DVAA, which itself is only a portion of Google's advertising business, are at issue in this matter. As such, any analysis that measures and reflects the performance of Google's advertising business in its entirety is overinclusive, in that it includes revenue and operating profit for products not at issue in this matter, including Google's owned & operated properties, such as Search and YouTube. As such, Mr. Andrien appears to conflate the performance of the at-issue DVAA products with that of the entirety of Google's advertising business. Similarly, measures of the performance of Alphabet as a whole (such as company-wide revenue or operating income) reflect the economic contributions of a multitude of Alphabet products and services unrelated to the allegations or even to DVAA.

60. DVAA represents a relatively modest fraction of Google's overall advertising business. As shown in **Table 5A**, for fiscal years 2018 through 2023 DVAA represented [redacted] as reported in the Company's Go/Ads P&Ls.[97]

[96] Andrien Report, ¶ 11.
[97] GOOG-AT-MDL-C-000018044. As shown in **Table 5B**, the results for revenue are similar using figures from Alphabet Forms 10-K.

Table 5A
Ads Revenue and Operating Profit Breakdown, 2014–2023[1]

[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]				
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]				
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]							
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]							
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Source: GOOG-AT-MDL-008927854; GOOG-AT-MDL-008928775; GOOG-AT-MDL-008928776; GOOG-AT-MDL-008928778; GOOG-DOJ-AT-02647833; GOOG-AT-MDL-009709864; GOOG-AT-MDL-C-000018044

Note:
[redacted]

61. To illustrate the size of the DVAA business relative to that of Google's overall advertising business, **Figures 1A** and **1B** present the share of Google's overall advertising revenue and operating profit, respectively, generated by DVAA for fiscal years 2014 through 2023. [98]

[98] As explained in Section VI, I understand that the cost allocation methods used to prepare internal DVAA P&Ls has changed over time. As a result, the operating profits that I present in **Table 5A** and those that underlie **Figure 1B** may not have been consistently calculated across the years.

Figure 1A

Revenue for DVAA as a Percentage of Revenue for Google's Ads Business as a Whole, 2014–2023

[redacted]

Source: GOOG-AT-MDL-008927854; GOOG-AT-MDL-008928775; GOOG-AT-MDL-008928776; GOOG-AT-MDL-008928778; GOOG-DOJ-AT-02647833; GOOG-AT-MDL-009709864; GOOG-AT-MDL-C-000018044

Note: [redacted]

Figure 1B

Operating Profit for DVAA as a Percentage of Operating Profit for Google's Ads Business as a Whole, 2014–2023

[redacted]

Source: GOOG-AT-MDL-008927854; GOOG-AT-MDL-008928775; GOOG-AT-MDL-008928776; GOOG-AT-MDL-008928778; GOOG-DOJ-AT-02647833; GOOG-AT-MDL-009709864; GOOG-AT-MDL-C-000018044

Note: [redacted]

62. Mr. Andrien appears to use his purported analysis of the performance of Google's advertising business as the basis for an opinion that the at-issue businesses represent a large or significant portion of Alphabet's overall business.[99] This is simply not the case. As shown in **Table 5B**, for fiscal years 2018 through 2023, Google Network revenue represented approximately 10–15% of Alphabet's overall revenue and approximately 13–17% of its overall ad revenue, based on numbers reported in its Form 10-K filings. Mr. Andrien fails to

[99] *See, e.g.*, Andrien Report, Charts 8 and 10 (showing advertising representing 82% [redacted] of Alphabet total revenue and operating profit, respectively).

explain why analyzing the performance of Alphabet as a whole or of Google's entire advertising business is relevant when the at-issue products represent only a relatively small portion of these businesses. I further note that Google Network revenue is itself overinclusive; it includes revenue from products that are not part of DVAA[100] and, as explained above, it also includes certain DVAA products that I understand are not at issue in this case.

Table 5B
Google Segment
Revenue Breakdown, 2013–2023

in millions	2013	2014	2015	2016	2017
Google Network	$13,650	$14,539	$15,033	$15,598	$17,616
Google Advertising	$51,072	$59,624	$67,390	$79,383	$95,577
Google Network %	*27%*	*24%*	*22%*	*20%*	*18%*
Alphabet	$55,519	$66,001	$74,989	$90,272	$110,855
Google Network %	*25%*	*22%*	*20%*	*17%*	*16%*

in millions	2018	2019	2020	2021	2022	2023	Total
Google Network	$20,010	$21,547	$23,090	$31,701	$32,780	$31,312	$236,876
Google Advertising	$116,461	$134,811	$146,924	$209,497	$224,473	$237,855	$1,423,067
Google Network %	*17%*	*16%*	*16%*	*15%*	*15%*	*13%*	*17%*
Alphabet	$136,819	$161,857	$182,527	$257,637	$282,836	$307,394	$1,726,706
Google Network %	*15%*	*13%*	*13%*	*12%*	*12%*	*10%*	*14%*

Source: Alphabet and Google 2015 10-K; Alphabet 2016 10-K; Alphabet 2017 10-K; Alphabet 2018 10-K; Alphabet 2019 10-K; Alphabet 2020 10-K; Alphabet 2021 10-K; Alphabet 2022 10-K; Alphabet 2023 10-K

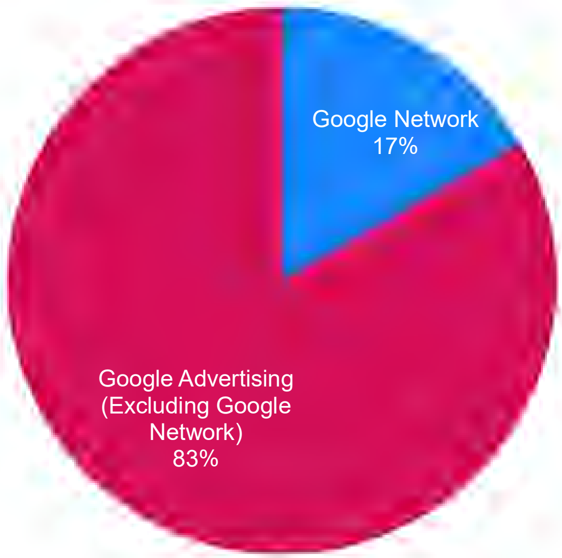
Note: This table contains data for each fiscal year drawn from most recent Form 10-K filing that reported segment-level data (e.g., data for 2021 drawn from 2023 10-K). Revenue as reported in Alphabet Form 10-K filings.

63. **Figures 2A** and **2B** depict the total revenue generated by Google Network relative to Google's total advertising revenue and total Alphabet revenue, respectively, for fiscal years 2013 through 2023.

[100] As I explained above, Google Network is broader than DVAA as it includes revenue from certain products not generally considered part of Google DVAA, such as AdSense for Search. As such, DVAA revenue represents an even smaller share of Alphabet total revenue.

Figure 2A

Total Revenue for Google Network as a Percentage of Total Google Advertising Revenue, 2013–2023

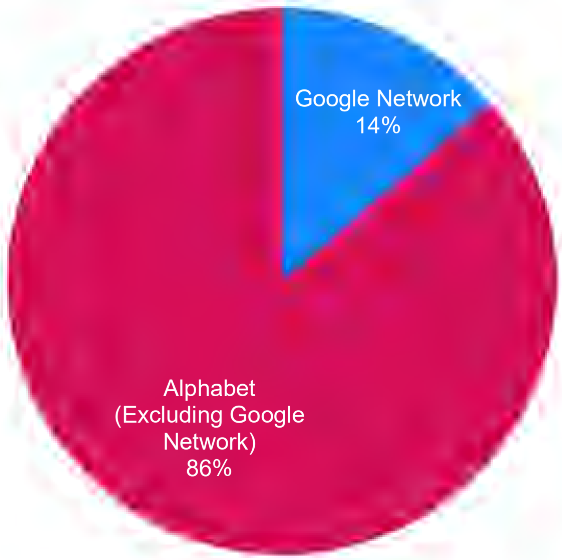


Source: Alphabet and Google 2015 10-K; Alphabet 2016 10-K; Alphabet 2017 10-K; Alphabet 2018 10-K; Alphabet 2019 10-K; Alphabet 2020 10-K; Alphabet 2021 10-K; Alphabet 2022 10-K; Alphabet 2023 10-K

Note: Total Revenue calculated as the sum of Revenues as reported for Google Advertising and Google Network in Alphabet Form 10-K filings for 2013–2023. Data for each fiscal year drawn from most recent Form 10-K filing that reported segment-level data (e.g., data for 2021 drawn from 2023 10-K).

Figure 2B

Total Revenue for Google Network as a Percentage of Alphabet Total Revenue, 2013–2023



Source: Alphabet and Google 2015 10-K; Alphabet 2016 10-K; Alphabet 2017 10-K; Alphabet 2018 10-K; Alphabet 2019 10-K; Alphabet 2020 10-K; Alphabet 2021 10-K; Alphabet 2022 10-K; Alphabet 2023 10-K

Note: Total Revenue calculated as the sum of Revenues as reported for Alphabet and Google Network in Alphabet Form 10-K filings for 2013–2023. Data for each fiscal year drawn from most recent Form 10-K filing that reported segment-level data (e.g., data for 2021 drawn from 2023 10-K).

64. Mr. Andrien fails to provide any basis for his assessment that Google's financial performance during the relevant period was "extraordinary" or why such "extraordinary" performance for a variety of Google businesses (many of which have little or nothing to do with DVAA) is informative or relevant to his opinions. As explained above, his basis for this claim largely appears to rest on a comparison of certain financial measures for Alphabet to the average of those for public companies that are represented in the S&P500 and Nasdaq Composite indices. As an initial matter, measures such as market capitalization are forward-looking and reflect stockholders' expectations of future growth, while stock returns reflect

changes in stockholders' expectations of an entity's growth prospects.[101] As a result, stock returns and market capitalization would seem to have little or no bearing on any purported benefits that resulted from Google's alleged misconduct during the relevant period, assuming this is what Mr. Andrien is trying to measure. Further, Mr. Andrien fails to explain why the stock market performance of the collection of companies represented in these indices—which, among others, include manufacturers, banks, retailers, and energy companies[102]—serves as a relevant benchmark for assessing the performance of Alphabet. Several of these companies are likely at different life-cycle stages and face different economic risks than Alphabet (and Google's DVAA business). For example, these indices include mature companies such as Walgreens and General Mills as well as companies with cyclical businesses such as Chevron, Southwest Airlines, and Airbnb.[103]

X. Mr. Andrien's Analysis of the Economic Effect of the Proposed Penalty

65. In concluding his report, Mr. Andrien claims that a hypothetical $29 billion penalty imposed on Google "would not be so burdensome as to impact the day-to-day operations of the company."[104] Mr. Andrien fails to define or explain what he means by "day-to-day operations" (which, in my experience, is not a term of art in accounting, financial analysis, or financial economics). As a result, his conclusion that a $29 billion penalty "would not…

[101] It appears that Mr. Andrien computes returns for these indices without including dividends, a non-trivial component of investor returns. Had Mr. Andrien properly calculated returns to these indices (inclusive of dividends), he would have found that, over the period from January 2, 2013 to June 3, 2024, the cumulative returns to an investment in the S&P500 and Nasdaq Composite were 348.1% and 507.6%, respectively. These returns are calculated using the closing levels of the S&P 500 Total Return Index and those of the Nasdaq Composite Total Return Index, respectively, which incorporate reinvested dividends. *See Refinitiv*. These values are naturally higher than those reported by Mr. Andrien because of his omission. *See* Andrien Report, ¶ 83, Footnote 236 ("The S&P 500 (SPX) and the Nasdaq Composite (COMP) have grown 261.28% and 440.72% respectively since the first trading day of 2013."). Because Alphabet paid its first-ever dividend on June 10, 2024, after the period Mr. Andrien evaluates, the dividend does not affect the Alphabet returns presented by Mr. Andrien. *See* Alphabet Inc. Form 10-Q for the quarterly period ended March 31, 2024 ("Alphabet 2024 Q1 10-Q"), pp. 26, 33; *see also* Alphabet Inc. Form 10-Q for the quarterly period ended June 30, 2024 ("Alphabet 2024 Q2 10-Q"), pp. 28, 37.
[102] S&P Dow Jones Indices, "Equity: S&P 500®," June 28, 2024, available at https://www.spglobal.com/spdji/en/idsenhancedfactsheet/file.pdf?calcFrequency=M&force_download=true&hostIdentifier=48190c8c-42c4-46af-8d1a-0cd5db894797&indexId=340, accessed on July 23, 2024; Nasdaq, "COMP: Nasdaq Composite: Industry Breakdown," July 23, 2024, available at https://indexes.nasdaqomx.com/Index/Breakdown/COMP, accessed on July 23, 2024.
[103] *See, e.g.,* Walgreens Boots Alliance Inc. Form 10-K for the fiscal year ended August 31, 2023, p. 1; General Mills Inc. Form 10-K for the fiscal year ended May 28, 2023, p. 4; Chevron Corporation Form 10-K for the fiscal year ended December 31, 2023, pp. 3, 20–21; Southwest Airlines Co. Form 10-K for the fiscal year ended December 31, 2023, p. 3; Airbnb, Inc. Form 10-K for the fiscal year ended December 31, 2023, pp. 6, 10.
[104] Andrien Report, ¶ 131.

impact the day-to-day operations" of Google is not testable because it is not defined in a specific manner.

66. Mr. Andrien's analysis of the "impact" of his proposed penalty does not appear to be based on any well-defined, supported methodology. While Mr. Andrien points to certain "metrics and ratios that financial analysts use to evaluate the economic and financial condition of a company" his basis for doing so is unclear; he indicates only that those metrics and ratios address "[**s**]**ome** key areas analysts **usually focus on**."[105] He goes on to say that "[a]nalysts **sometimes** have preferences of certain metrics and ratios versus others but there is not a set of metrics or ratios that will capture the full information set of a company."[106] In my view, this is not sufficient to justify or even explain how these ratios and measures can reliably inform his sweeping conclusions, including that a $29 billion fine "would not impact" the Company's "day-to-day operations." Moreover, Mr. Andrien's analysis fails to address certain important factors that would seem relevant to assessing the impact the proposed penalty may have on Alphabet and its shareholders.

67. Mr. Andrien fails to consider the magnitude of his proposed $29 billion penalty relative to any relevant benchmarks, either for Alphabet as a whole or DVAA.

68. If we consider the Company's capital expenditures, for example, Mr. Andrien's proposed $29 billion penalty is approximately the same magnitude as the Company's total capital expenditures for fiscal year 2023 (of $32.3 billion).[107] As I discuss below, if it were necessary to reduce these expenditures to finance (or partially finance) such a penalty, I understand, based on recent statements and disclosures by the Company, that it could have adverse consequences for the Company's business, competitive position, and its ability to innovate.

69. Based on recent public disclosures, including its recent second quarter 2024 earnings results and call with investors, the Company has made and will continue to make substantial investments in AI infrastructure and capabilities; a significant fraction of the Company's ongoing capital expenditures are related to AI (for example, in servers, network equipment, and data centers). In its fiscal year 2023 Form 10-K filing Alphabet indicated that it expects "that [its] capital expenditures will increase, including the expected increase in [its] technical infrastructure investment to support the growth of [its] business and [its] long-term

[105] Andrien Report, ¶ 131.
[106] Andrien Report, ¶ 131.
[107] Alphabet 2023 10-K, p. 42.

initiatives, in particular in support of artificial intelligence (AI) products and services."[108] Indeed, in the first half of 2024 Alphabet incurred over $25 billion in capital expenditures, primarily for investments in technical infrastructure.[109] In its most recent (second quarter) Form 10-Q filing, the Company indicated that it expected investments in technical infrastructure to "increase relative to 2023...to support the growth of [its] business and [its] long-term initiatives, in particular in support of AI products and services."[110] In addition to capital expenditures, during the same period Alphabet incurred R&D expenditures of over $23 billion, which also include AI-related investments.[111] Alphabet characterizes its investments in AI as "critical," noting that "AI technology and services … require significant investment, including development and operational costs, to meet the changing needs and expectations of [its] existing users and attract new users" and that its "financial condition and operating results may also suffer if [its] products and services are not responsive to the evolving needs and desires of [its] users, advertisers, publishers, customers, and content providers."[112] Mr. Andrien fails to provide any analysis, including analysis based on any reliable, supported methodology, that would support a conclusion that having to pay his proposed $29 billion penalty would not adversely affect the Company's ability to sustain its planned investment program, including these AI investments. Indeed, he seems to be proposing that an amount equal to a public company's *entire annual* capital expenditures is economically unimportant such that payment of this amount would not impact its "day-to-day operations." This assertion seems implausible based on any reasonable point of reference.

70. It is also instructive to consider another benchmark, namely the magnitude of Mr. Andrien's proposed penalty relative to the aggregate profits of DVAA. Mr. Andrien's proposed $29 billion penalty is [redacted], as reported in his Exhibit 2.[113] As another point of reference, Mr. Andrien's proposed penalty is approximately equal to the total annual revenue

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[108] Alphabet 2023 10-K, p. 3. *See also* Alphabet 2023 10-K, p. 42 ("We expect to increase, relative to 2023, our investment in our technical infrastructure, including servers, network equipment, and data centers, to support the growth of our business and our long-term initiatives, in particular in support of AI products and services.").
[109] Alphabet 2024 Q1 10-Q, p. 33; Alphabet 2024 Q2 10-Q, p. 37.
[110] Alphabet 2024 Q2 10-Q, pp. 37, 45.
[111] Alphabet 2024 Q2 10-Q, pp. 32, 41.
[112] Alphabet 2023 10-K, p. 11. In the Company's Q2 2024 earnings call, its CEO, Mr. Sundar Pichai, responded in the following way to an analyst's question about the extent of the Company's investments in AI: "…the risk of underinvesting is dramatically greater than the risk of overinvesting for us here…I think not investing to be at the front here, I think, definitely has much more significant downsides." *See* Alphabet Q2 2024 Earnings Call, July 23, 2024, available at https://abc xyz/assets/bd/7b/d5783184953be8bcc2c5a42aee8/2024-q2-earnings-transcript.pdf, accessed on July 30, 2024.
[113] Andrien Report, Exhibit 2.

of Google Network, which as mentioned above, includes but is not limited to the DVAA products at issue; in 2023, this amount was around $31 billion.[114] As another benchmark, the proposed penalty represents [redacted]. Mr. Andrien fails to explain how one could reasonably conclude that a $29 billion penalty would not affect Google's "day-to-day operations" when it is [redacted].

71. Mr. Andrien speculates about how Google might be able to pay a $29 billion penalty (without, as he claims, affecting day-to-day operations): he asserts that Alphabet "can pause, delay or reduce its share repurchases to pay the penalty assessed in this case and avoid any impact to its business greater than what it has already determined is acceptable."[115] It appears that Mr. Andrien is referring to Alphabet's recent announcement that its board authorized "the company to repurchase up to an additional $70.0 billion of its Class A and Class C shares."[116] At the same time as the repurchase announcement, Alphabet announced its first ever quarterly dividend (of approximately $2.5 billion) and that it "intends to" pay dividends each quarter "subject to review and approval by the company's Board of Directors in its sole discretion", i.e., the company initiated a regular quarterly dividend.[117] This is the first dividend in the Company's history.[118]

72. Mr. Andrien, however, does nothing to assess the impact on the Company and its shareholders if Alphabet were forced, as a result of the penalty, to reverse or partly reverse these decisions and discontinue or decrease the share repurchase or the dividend program. If such a reversal were viewed negatively by the market it could negatively impact Alphabet's share price and so compound the effect of the penalty on Google's day-to-day operations, directly affecting the Company's shareholders.

[114] Alphabet 2023 10-K, p. 35.
[115] Andrien Report, ¶ 139.
[116] Alphabet Inc. Form 8-K, Exhibit 99.1, filed on April 25, 2024.
[117] Andrien Report, ¶ 82. *See also* Alphabet Inc. Form 8-K, Exhibit 99.1, filed on April 25, 2024; Alphabet 2024 Q2 10-Q, p. 37 ("Dividend payments to stockholders of Class A, Class B, and Class C shares were $1.2 billion, $173 million, and $1.1 billion, respectively, totaling $2.5 billion for the three months ended June 30, 2024.").
[118] *See, e.g.*, Stephen Morris and Richard Waters, "Alphabet Surges Past $2tn Valuation as Search Giant Announces First Dividend," *Financial Times*, April 26, 2024, available at https://www ft.com/content/23b4b384-5971-4f91-a9c9-8a779d10b6bc?shareType=nongift, accessed on July 24, 2024.

Executed this 30 July, 2024

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APPENDIX A

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Education

B.Ec. (First Class Honours), Accounting/Finance, Macquarie University, 1985.
M.S., Applied Economics, University of Rochester, 1988.
Ph.D., Accounting (major area), Finance (minor area), University of Rochester, 1989.

Appointments

University of Chicago, Booth School of Business
Sidney Davidson Distinguished Service Professor of Accounting, 2023-
Deputy Dean for Faculty, 2015-2016, 2017-2024.
Interim Dean, 2016-2017.
Eric J. Gleacher Distinguished Service Professor of Accounting, 2014-2022.
John P. and Lillian A. Gould Professor of Accounting, 2006-2013.
Executive Director, Accounting Research Center, 2011-2016.
Professor of Accounting and Neubauer Family Faculty Fellow, 2005-2006.
Neubauer Faculty Fellow and Visiting Professor of Accounting, 2003-2004.

Independent Trustee and Audit Committee Chair, Harbor Funds, Harbor Funds II, and Harbor ETF Trust, 2020-

Senior Fellow, Asian Bureau of Finance and Economic Research (ABFER), 2017-

University of Melbourne, Faculty of Business and Economics
Professorial Fellow, 2010-.

Journal of Accounting Research
Senior Editor, 2006-2021.

Journal of Accounting & Economics
Editor, 2000-2005.
Associate Editor, 1994-2000.

University of Michigan Business School (now Ross School of Business)
KPMG Professor of Accounting, 1998-2005
Accounting Area Chair, 2001-2003
Professor of Accounting, 1997-2005
Associate Professor of Accounting, 1993-1997
Assistant Professor of Accounting, 1989-1993

Coopers & Lybrand (Sydney)
Auditor, 1980-82.

Scholarly Honors and Awards

FARS 2020 Best Paper Prize for "Run EDGAR Run: SEC Dissemination in a High Frequency World." With Jonathan L Rogers and Sarah L. C. Zechman.

Distinguished Ph.D. Mentoring Award, 2020, Financial Reporting Section, American Accounting Association.

BlackRock prize for best paper, 2015 Review of Accounting Studies conference ("The role of the media in disseminating insider trading news." With Jonathan Rogers and Sarah Zechman.)

Hillel J Einhorn Excellence in Teaching Award, 2014.

Emory Williams Award for Teaching Excellence, 2013.

FARS 2009 Best Paper Prize for "Earnings Momentum and Earnings Management." With James Myers and Linda Myers.

Jensen Prize for best paper in Corporate Finance and Organizations published in the *Journal of Financial Economics* in 2004. ("Are Dividends Disappearing? Dividend Concentration and the Consolidation of Earnings." With Harry DeAngelo and Linda DeAngelo.)

CQA/IBES Research Competition, 1998. ("Earnings Surprises, Growth Expectations, and Stock Returns or Don't Let an Earnings Torpedo Sink Your Portfolio." With Richard Sloan. Review of Accounting Studies, 7, 2/3, June/September 2002: 289-312.)

KPMG Peat Marwick Faculty Fellow 1993-1996.
KPMG Peat Marwick Research Fellow 1991-1993.
Deloitte Haskins & Sells Foundation Doctoral Fellow 1986-88.
University of Rochester Sproull Fellow 1985-1987.

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Main Publications

"Options Markets and Stock Return Volatility." Journal of Financial Economics 23, 1, June 1989: 61-78.

"Options Markets and the Information Content of Accounting Earnings Releases." Journal of Accounting & Economics 13, 3, October 1990: 191-211.

"Dividends and Losses." With Harry DeAngelo and Linda DeAngelo. Journal of Finance 47, 5, December 1992: 1837-1863.

"The Investment Opportunity Set and Accounting Procedure Choice: Preliminary Evidence." Journal of Accounting & Economics 16, 4, October 1993: 407-445.

"Accounting Choice in Troubled Companies." With Harry DeAngelo and Linda DeAngelo. Journal of Accounting & Economics 17, 1-2, January 1994: 113-143.

"How Do Taxes Affect Investors' Stock Market Realizations? Evidence from Tax-Return Panel Data." With H. Nejat Seyhun. Journal of Business 67, 2, April 1994: 231-262.

"Why Firms Voluntarily Disclose Bad News." Journal of Accounting Research 32, 1, Spring 1994: 38-60. (This article is abstracted in The CFA Digest 24, 4, Fall 1994.)

"Reversal of Fortune: Dividend Policy and the Disappearance of Sustained Earnings Growth." With Harry DeAngelo and Linda DeAngelo. Journal of Financial Economics 40, 3, March 1996: 341-371.

"Earnings Disclosures and Stockholder Lawsuits." Journal of Accounting & Economics 23, 3, November 1997: 249-282.

"Determinants of the Valuation Allowance for Deferred Tax Assets under SFAS-109." With Gregory S. Miller. The Accounting Review 73, 2, April 1998: 213-233.

"An Empirical Examination of Conference Calls as a Voluntary Disclosure Medium." With Richard Frankel and Marilyn Johnson. Journal of Accounting Research 37, 1, Spring 1999: 133-150.

"Earnings Management: Reconciling the Views of Accounting Academics, Practitioners, and Regulators." With Patricia Dechow. Paper delivered at the AAA/FASB Financial Reporting Issues Conference in December, 1999. Accounting Horizons, 14, 2, June 2000: 235-250.

"Special Dividends and the Evolution of Dividend Signaling." With Harry DeAngelo and Linda DeAngelo. Journal of Financial Economics, 57, 3, September 2000: 309-354.

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"Earnings Surprises, Growth Expectations, and Stock Returns or Don't Let an Earnings Torpedo Sink Your Portfolio." With Richard Sloan. Review of Accounting Studies, 7, 2/3, June/September 2002: 289-312.

- Winner, 1998 Chicago Quantitative Alliance/IBES Research Competition.

"Large Sample Tests of the Debt Covenant Hypothesis." With Ilia Dichev. Journal of Accounting Research, 40, 4, September 2002: 1091-1123.

"The Role of Supplementary Statements with Management Earnings Forecasts." With Amy P. Hutton and Gregory S. Miller. Journal of Accounting Research 41, 5, December 2003: 867-890.

"Employee Stock Options, EPS Dilution, and Stock Repurchases." With Daniel Bens, Venky Nagar, and M. H. Franco Wong. Journal of Accounting and Economics, 36, 1-3, December 2003: 51-90.

"Are Dividends Disappearing? Dividend Concentration and the Consolidation of Earnings." With Harry DeAngelo and Linda DeAngelo. Journal of Financial Economics, 72, 3, June 2004: 425-456.

- Jensen Prize for best paper, Corporate Finance and Organizations.

"Earnings Momentum and Earnings Management." With James Myers and Linda Myers. Journal of Accounting, Auditing and Finance, 22, 2, Spring 2007: 249-284.

- FARS Best paper prize, 2009.

"Does Earnings Guidance Affect Market Returns? The Nature and Information Content of Aggregate Earnings Guidance." With Carol Anilowski and Mei Feng. Journal of Accounting and Economics 44, 1-2, September 2007: 36-63.

"The Evolving Relation between Earnings, Dividends, and Stock Repurchases." Journal of Financial Economics 87, 3, March 2008: 582-609.

"Accounting for Intangibles – A Critical Review of Policy Recommendations." Accounting and Business Research 38, 3, 2008: 191-204.

"A reply to Lev's rejoinder to 'Accounting for Intangibles – A Critical Review of Policy Recommendations.'" Accounting and Business Research 38, 3, 2008: 215-216.

"The Rise of Deferred Tax Assets in Japan: The Role of Deferred Tax Accounting in the Japanese Banking Crisis." Journal of Accounting and Economics 46, 2-3, 2008: 218-239. Lead article.

"Corporate Payout Policy." With Harry DeAngelo and Linda DeAngelo. Foundations and Trends in Finance 3, 2-3, 2008: 95-287.

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"Management Forecasts in Japan: An Empirical Study of Forecasts that are Effectively Mandated" (Previously titled "When Voluntary Disclosure Isn't Voluntary: Management Forecasts in Japan.") With Kazuo Kato and Michio Kunimura. The Accounting Review 84, 5 (September 2009): 1575-1606.

"Earnings Guidance and Market Uncertainty." With Jonathan Rogers and Andrew Van Buskirk. Journal of Accounting and Economics 48, 1 (October 2009): 90-109.

"Implications for GAAP from an analysis of positive research in accounting." With S. P. Kothari and Karthik Ramanna. (Previously titled: "What Should GAAP Look Like? A Survey and Economic Analysis.") Journal of Accounting and Economics 50, 2-3 (December 2010): 246-286. (Invited review paper.)

"What Do Dividends Tell Us About Earnings Quality?" With Eugene Soltes. Review of Accounting Studies 16, 1 (March 2011): 1-28.

"Measuring Securities Litigation Risk." With Irene Kim. Journal of Accounting and Economics 53, 1-2 (February-April 2012): 290-310.

"Audit Quality and Auditor Reputation: Evidence from Japan." With Suraj Srinivasan. The Accounting Review 87, 5 (September 2012): 1737-1765.

"The Politics of Accounting Standard-Setting: A Review of Empirical Research." With Brandon Gipper and Brett J. Lombardi. Australian Journal of Management 38, 3 (December 2013): 523-551.

"Payout policy through the financial crisis: The growth of repurchases and the resilience of dividends." With Eric Floyd and Nan Li. Journal of Financial Economics 118, 2 (November 2015): 299-316.

"The role of the media in disseminating insider trading news." With Jonathan L. Rogers and Sarah L. C. Zechman. Review of Accounting Studies 21, 3 (September 2016): 711-739.

- *BlackRock prize for best paper, Review of Accounting Studies conference, 2015.*

"Is Japan Really a "Buy"? The Corporate Governance, Cash Holdings, and Economic Performance of Japanese Companies." With Kazuo Kato and Meng Li. Journal of Business Finance & Accounting 44, 3 & 4 (March/April 2017): 480-523.

"Run EDGAR Run: SEC Dissemination in a High Frequency World." With Jonathan L Rogers and Sarah L. C. Zechman. Journal of Accounting Research 55, 2 (May 2017): 459-505.

- *FARS Best paper prize, 2020.*

"Importing Activists: Determinants and Consequences of Increased Cross-border Shareholder Activism." With Mark G. Maffett and Anya Nakhmurina. Journal of Accounting & Economics 74, 2-3 (November-December 2022). https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3721680

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Conference Proceedings

"Stock Returns, Trading Volume, and Bid-Ask Spreads Around Earnings Announcements: Evidence from the NASDAQ National Market System." Proceedings: Seminar on the Analysis of Security Prices, 36, 1, May 1991: 289-329. SSRN version https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2143649

Current Working Papers

"The Evolution of Audit Market Structure and the Emergence of the Big Four: Evidence from Australia." With Matthew Pinnuck and Colin Ferguson (deceased). Revised, May 2023. Under revision. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2431727

"Moving Forward: Management Guidance and Earnings Announcement Returns." With Yao Lu. April 2020, Revised September 2020. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3687764

"Corporate Managers' Perspectives on Forward-Looking Guidance: Survey Evidence." With Andrew C. Call, Paul Hribar, and David Volant. Revised, August 2023. Presented at *2023 JAE Conference*; under revision. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4214740

"Do Actions Speak Louder than Words? The Relation Between Payouts and Guidance Since 2000." With Yao Lu. August 2023. Under revision. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4322036

Invited Discussions and Commentaries (non-refereed)

"Are Disclosures About Bank Derivatives and Employee Stock Options 'Value Relevant'?" Journal of Accounting & Economics 22, 1-3, Aug.-Dec. 1996: 393-405.

"What Motivates Managers' Choice of Discretionary Accruals?" With Victor L. Bernard. Journal of Accounting & Economics 22, 1-3, Aug.-Dec. 1996: 313-325.

"Do Options Markets Improve Informational Efficiency?" Contemporary Accounting Research 14, 2, Summer 1997: 193-201.

"How Well Does Net Income Measure Firm Performance? A Discussion of Two Studies." Journal of Accounting & Economics, 26, 1-3, January 1999: 105-111.

"Should Firms Disclose Everything to Everybody? A Discussion of 'Open versus closed conference calls: The determinants and effects of broadening access to disclosure.'" Journal of Accounting and Economics 34, 1-3, January 2003: 181-187.

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'Comments on "The Effects of Taxes on Market Responses to Dividend Announcements and Payments: What Can We Learn from the 2003 Dividend Tax Cut?"' by Raj Chetty, Joseph Rosenberg, and Emmanuel Saez, in Alan J. Auerbach, James R. Hines, Jr., and Joel Slemrod, eds., Taxing Corporate Income in the 21st Century (Cambridge University Press, 2007): 36-40.

'Discussion of "The implications of unverifiable fair-value accounting: Evidence from the political economy of goodwill accounting"' Journal of Accounting and Economics 45, 2-3, August 2008, 282-288.

'Discussion of "Accounting standards and debt covenants: Has the "Balance Sheet Approach" led to a decline in the use of balance sheet covenants?"' Journal of Accounting and Economics 52, 2-3, November 2011: 203-208.

"Accounting research in the Japanese setting." The Japanese Accounting Review, 1, 2011: 135-140.

"How should we think about earnings quality? A discussion of "Earnings quality: Evidence from the field." With Mark W. Nelson. Journal of Accounting and Economics 56, 2-3 (December 2013): 34-41.

"The Evolving Disclosure Landscape: How Changes in Technology, the Media, and Capital Markets Are Affecting Disclosure." With Gregory S. Miller. Journal of Accounting Research 53, 2 (May 2015): 221-239.

Other Publications

"Are the SEC's Safe Harbor Provisions Effective in Encouraging the Disclosure of Forward-Looking Information?" Financial Analysts Journal 51, 4, July-August 1995: 38-44.

"Issues in Foreign Exchange Hedge Accounting." With Michael H. Moffett. Journal of Applied Corporate Finance 8, 5, Fall 1995: 82-94.

"Bad News Rings True." With Amy P. Hutton and Gregory S. Miller. Investor Relations Quarterly 6, 2, 2004: 49-56.

"Japan's Window Dressing Hid Olympus Fraud," Bloomberg Opinion, November 30, 2011, https://www.bloomberg.com/opinion/articles/2011-12-01/japan-s-window-dressing-hid-olympus-fraud-commentary-by-douglas-skinner

"Why U.S. Companies Continue to Pay Dividends," Bloomberg Opinion, April 11, 2012, https://www.bloomberg.com/opinion/articles/2012-04-11/why-u-s-companies-continue-to-pay-dividends

APPENDIX A

"Corporate America is Enriching Shareholders at the Expense of the Economy." fivethirtyeight.com July 15, 2014. http://fivethirtyeight.com/features/corporate-america-is-enriching-shareholders-at-the-expense-of-the-economy/

The Financial Accounting Standards Committee of the AAA is charged with responding to requests by standards setters on issues related to financial reporting. As a member of that Committee from 1999 until 2002 I contributed to comment letters to the Financial Accounting Standards Board (FASB), the International Accounting Standards Committee (IASC), and the U.S. Securities and Exchange Commission (SEC). Published versions of these comment letters for which I served as principal author are as follows:

- Response to the FASB Preliminary Views: Reporting Financial Instruments and Certain Related Assets and Liabilities at Fair Value. (with J. M. Wahlen, Chair, J. R. Boatsman, R. H. Herz, G. J. Jonas, K. G. Palepu, S. G. Ryan, K. Schipper, and C. M. Schrand). Accounting Horizons December 2000, Vol. 14, No. 4, pp. 501-508.
- Implications of Accounting Research for the FASB's Initiatives on Disclosure of Information about Intangible Assets. With L. A. Maines, Chair, E. Bartov, P. M. Fairfield, D. E. Hirst, T. E. Iannaconi, R. Mallett, C. M. Schrand, L. Vincent. Accounting Horizons June 2003, Vol. 17, No. 2, pp. 175-185.

Selected Media Coverage

"Dividends, Wall Street's Battered Status Symbol," The New York Times, February 13, 2016.

"As Stock Prices Slump, Don't Count on Buybacks," Wall Street Journal, January 25, 2016.

"Fast Traders Are Getting Data From SEC Seconds Early," Wall Street Journal, October 29, 2014.

"High-frequency traders said to get SEC filings early," Financial Times, October 29, 2014.

"Certain Traders May Get Early Looks at S.E.C. Filings, Paper Finds," The New York Times, October 29, 2014.

"Flush with Cash, Apple Plans Buyback and Dividend," The New York Times, March 19, 2012.

Professional Activities

Journal of Accounting Research: Senior Editor, 2006-2021.

Accounting and Finance, Editorial Board, 2012-2016.

Asia-Pacific Journal of Accounting & Economics, Associate Editor, 1999-2005.

Journal of Accounting & Economics:
Editor, 2000-2005.
Associate Editor, 1994-2000.

The Accounting Review, Editorial Advisory and Review Board, 1992-1996; 1997-1999.

Review of Accounting Studies, Co-Editor, 1999-2000.

Ad hoc referee for numerous accounting and finance journals.

Member: American Accounting Association, American Finance Association.

American Accounting Association Committees:

- Financial Accounting Standards Committee, 1999-2002.
- AAA/FASB Annual Financial Reporting Issues Conference Organizing Committee, 1999, 2000, 2005.
- 2001-2002 Competitive Manuscript Prize Committee.

Ph.D. Committees (chronological order with initial placements)

At Michigan:
Arun Kumar (Finance)
Christine Botosan. Washington University, St Louis.
Li Li Eng. Singapore National University.
Karen Nelson. Stanford.
Lillian Mills. Arizona.
Brian Bushee. Harvard Business School.
Marlene Plumlee (Chair). Utah.
David Heike (Finance). Western Ontario.
Timothy Burch (Finance). Miami (FL).
Gregory Miller (Chair). Harvard Business School.
Mark Bradshaw. Harvard.
Anchada Charoenrook (Finance). Vanderbilt.
Darren Roulstone (Co-chair). Chicago.
Linda Myers (Chair). Washington (Seattle).
Irem Tuna (Chair). Wharton.
Scott Richardson. Wharton.
Fai Cang (Finance). Vanderbilt.
Jef Doyle. Utah.
Irene Kim (Chair). Duke.
Mei Feng (Chair). Pittsburgh.
Wei Tang (Chair). Georgetown.

At Chicago:
Regina Wittenberg Moerman. Wharton.
Yu Gao. Minnesota.
Eugene Soltes (Chair). Harvard Business School.
Ningzhong Li. London Business School.

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Lawrence Takeuchi (finance).
Pepa Kraft. NYU.
Jeff Ng. Chinese University of Hong Kong.
Anna Costello. (Chair). MIT.
Alon Kalay. Columbia.
Jonathan Milian. (Chair). Florida International University.
Meng Li (Co-chair). UT-Dallas.
Joao Granja. MIT.
Christine Cuny. NYU.
Joshua Madsen (Chair). Minnesota.
Marina Niessner (finance). Yale.
Eric Floyd. Rice.
Nan Li (Chair). Toronto.
Gerardo Perez Cavazos (Chair). Harvard Business School.
Frank Zhou (Chair). Wharton.
Matthew Bloomfield. Wharton.
Brett Lombardi (Chair). Monash (Australia).
Oleg Kuriukhin. Cornerstone Research.
Anya Nakhmurina. Yale SOM.
Johanna Shin. Capital Group.
Yao Lu. Cornell (Johnson).

Recent presentations, discussions, and talks.

2024: ABFER Singapore (discussant); FASB Financial Reporting Conference (discussant); Tulane mini-accounting conference.

Last updated: 2 July 2024.

APPENDIX B

Douglas J. Skinner, Expert Reports and Testimony

Expert declaration; *Pershing Square Capital Management L.P., Valeant Pharmaceuticals, Inc. et al. v. Allergan, Inc. et al.*, in the Court of Chancery of the State of Delaware, C.A. No. 10057-CB. (2014).

Affidavit; *United States of America v. Todd S. Farha, Thaddeus M.S. Bereday, Paul L. Behrens, William L. Kale, and Peter E. Clay,* United States District Court, Middle District of Florida, Tampa Division, Case No. 8:11-cr-115-T-30MAP, 18 U.S.C. § 371, 18 U.S.C. § 1035, 18 U.S.C. § 1347, 18 U.S.C. § 1001, 18 U.S.C. § 982(a)(7) (2014).

Expert reports and cross examination testimony; *Jacqueline Coffin and Sandra Lowry v. Atlantic Power Corporation, Barry Welch and Terrence Ronan*, in the Ontario Superior Court of Justice, Court File No. CV-13-480939-00CP (2014 - 2015).

Expert reports and trial testimony; *Exelon Corporation v. Commissioner of Internal Revenue*, in the United States Tax Court, Docket Nos. 29183-13 and 29184-13 (2015).

Expert reports and deposition; *Baker Hughes Incorporated v. United States of America*, United States District Court, Southern District of Texas, Civil Action H-15-2675 (2017).

Expert report and deposition; *SEC v. RPM International et al.*, United States District Court for the District of Columbia, Civil Action No. 16-1803 (ABJ) (2018, 2019).

Expert report and deposition; *SEB Investment Management AB, Individually and on behalf of others similarly situated v. Endo International plc et al.*, United States District Court for the Eastern District of Pennsylvania, Civil Action No. 2: 17-CV-3711-TJS (2019).

Expert reports and trial testimony; *Tribune Media Company, f.k.a. Tribune Company & Affiliates v. Commissioner of Internal Revenue*, in the United States Tax Court, Docket Nos. 20940-16 and 20941-16 (2019).

Expert reports and depositions; *SEB Investment Management AB, Individually and on behalf of others similarly situated v. Symantec Corporation and Gregory S. Clark*, United States District Court Northern District of California, Case No.: 3:18-cv-02902-WHA (2020, 2021).

Expert report and deposition; *In re Allergan plc Securities Litigation*, United States District Court for the Southern District of New York, Civil Action No. 18-cv-12089 (2020, 2021).

Expert reports and depositions; Alexandre Pelletier, Individually and on behalf of others similarly situated v. Endo International plc et al., United States District Court for the Eastern District of Pennsylvania, Civil Action No. 2: 17-cv-05114-MMB (2020, 2021).

Expert reports and depositions; Purple Mountain Trust v. Wells Fargo & Company, et al., United States District Court Northern District of California, Civil Action No. 3:18-cv-03948-JD (2020, 2021).

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Expert reports and deposition; *Washtenaw County Employees Retirement System, Individually and on behalf of others similarly situated v. Walgreen Co. et al.,* United States District Court Northern District of Illinois Eastern Division, No. 1:15-cv-3187 (2020, 2021).

Export report and deposition; *In re Novo Nordisk Securities Litigation*, United States District Court District of New Jersey, Master File No.: 3:17-cv-00209-BRM-LHG (2020, 2021).

Affidavit (expert report) and deposition; *Badesha Harpreet and Cronos Group Inc., et al.*, Ontario Superior Court of Justice, Court File No.: CV-20-00641990-00CP (2021).

Expert report and deposition; *Plumbers & Pipefitters National Pension Fund and Juan Francisco Nieves, as Trustee of the Gonzales Coronado Trust, Individually and on Behalf of All Others Similarly Situated v. Kevin Davis and Amir Rosenthal*, United States District Court Southern District of New York, Civil Action No. 1:16-CV-3591-GHW (2021).

Expert report, deposition, and trial testimony; *In Re CVR Refining, LP Unitholder Litigation.* In the Court of Chancery of the State of Delaware. Consolidated C.A. No. 2019-0062-KSJM (2021).

Expert reports, declaration, and depositions; *Christakis Vrakas, et al., v. United States Steel Corporation, et al.*, United States District Court Western District of Pennsylvania, Civil Action No. 17-579 (2021).

Expert report and deposition; *Gabby Klein et al., Individually and on behalf of others similarly situated v. Altria Group Inc., et al.*, United States District Court Eastern District of Virginia, Richmond Division, Civil Action No. 3:20-cv-00075-DJN (2021).

Expert report and deposition; *In Re Google Play Developer Antitrust Litigation*, United States District Court Northern District of California, Case No. 3:20-cv-05792-JD (2022).

Expert report; *In Re Maxar Technologies, Inc. Shareholder Litigation*, Superior Court of California, County of Santa Clara, Case No.: 19CV357070 (2022).

Expert report, deposition; *In Re Google Play Store Antitrust Litigation*, United States District Court Northern District of California, Case No. 3:21-md-02981-JD (2022, 2023).

Trial testimony; *Epic Games, Inc. vs. Google, LLC., et al.*, United States District Court Northern District of California, No. 3:20-cv-05671-JD (2023).

Expert report, deposition; *United States of America et al. vs. Google LLC*, United States District Court for the Eastern District of Virginia, Civil Action No. 1:23cv00108 (2024).

Expert declaration, deposition; *Richard J. Tornetta, individually and on behalf of all others similarly situated and derivatively on behalf of nominal defendant Tesla, Inc. v. Elon Musk, et al., and Tesla, Inc., Nominal Defendant.* In the Court of Chancery of the State of Delaware, Civil Action No. 2018-0408-KSJM (2024).

APPENDIX C

Documents Relied Upon List

Bates Stamped Documents

- GOOG-AT-MDL-001056062
- GOOG-AT-MDL-001950473
- GOOG-AT-MDL-002182530
- GOOG-AT-MDL-003206332
- GOOG-AT-MDL-004021793
- GOOG-AT-MDL-004039971
- GOOG-AT-MDL-004326981
- GOOG-AT-MDL-006876286
- GOOG-AT-MDL-008928775
- GOOG-AT-MDL-008928776
- GOOG-AT-MDL-008927854
- GOOG-AT-MDL-008928778
- GOOG-AT-MDL-008930610
- GOOG-AT-MDL-008930806
- GOOG-AT-MDL-009017821
- GOOG-AT-MDL-009017857
- GOOG-AT-MDL-009068311
- GOOG-AT-MDL-009643893
- GOOG-AT-MDL-009709671
- GOOG-AT-MDL-009709864
- GOOG-AT-MDL-009755689

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- GOOG-AT-MDL-015133684
- GOOG-AT-MDL-015133962
- GOOG-AT-MDL-019564516
- GOOG-AT-MDL-019564626
- GOOG-AT-MDL-C-000017359
- GOOG-AT-MDL-C-000018044
- GOOG-AT-MDL-C-000018256
- GOOG-DOJ-06206871
- GOOG-DOJ-11916795
- GOOG-DOJ-AT-02642407
- GOOG-DOJ-AT-02643272
- GOOG-DOJ-AT-02645423
- GOOG-DOJ-AT-02645446
- GOOG-DOJ-AT-02645470
- GOOG-DOJ-AT-02645766
- GOOG-DOJ-AT-02647833
- GOOG-DOJ-AT-02649870

Academic Articles and Books

- Joshua Rosenbaum and Joshua Pearl, *Investment Banking: Valuation, Leveraged Buyouts, and Mergers & Acquisitions*, Second Edition (Hoboken, NJ: John Wiley & Sons, Inc., 2013)
- Srikant M. Datar and Madhav V. Rajan, *Horngren's Cost Accounting: A Managerial Emphasis*, Sixteenth Edition (Hoboken, NJ: Pearson, 2018)

Data

- *Refinitiv*

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Depositions and Expert Reports

- Deposition of Jessica Mok, November 10, 2023
- Expert Report of Jeffrey S. Andrien, June 7, 2024, and Backup Materials

Legal Documents

- Defendant Google LLC's Responses and Objections to Plaintiffs' Second Set of Interrogatories, *The State of Texas, et al. v. Google LLC*, April 8, 2024
- Fourth Amended Complaint, *In Re: Google Digital Advertising Antitrust Litigation*, May 5, 2023
- Opinion and Order re Motion to Dismiss, *In Re: Google Digital Advertising Antitrust Litigation*, September 13, 2022

SEC Filings

- Airbnb, Inc. Form 10-K for the fiscal year ended December 31, 2023
- Alphabet Inc. Form 8-K, Exhibit 99.1, filed on April 25, 2024
- Alphabet Inc. and Google Inc. Form 10-K for the fiscal year ended December 31, 2015
- Alphabet Inc. Form 10-K for the fiscal year ended December 31, 2016
- Alphabet Inc. Form 10-K for the fiscal year ended December 31, 2017
- Alphabet Inc. Form 10-K for the fiscal year ended December 31, 2018
- Alphabet Inc. Form 10-K for the fiscal year ended December 31, 2019
- Alphabet Inc. Form 10-K for the fiscal year ended December 31, 2020
- Alphabet Inc. Form 10-K for the fiscal year ended December 31, 2021
- Alphabet Inc. Form 10-K for the fiscal year ended December 31, 2022
- Alphabet Inc. Form 10-K for the fiscal year ended December 31, 2023
- Alphabet Inc. Form 10-Q for the quarterly period ended March 31, 2024
- Alphabet Inc. Form 10-Q for the quarterly period ended June 30, 2024
- Chevron Corporation Form 10-K for the fiscal year ended December 31, 2023

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- General Mills Inc. Form 10-K for the fiscal year ended May 28, 2023
- Google Inc. Form 10-K for the fiscal year ended December 31, 2014
- Google Inc. Form 424B4, August 18, 2004
- Southwest Airlines Co. Form 10-K for the fiscal year ended December 31, 2023
- Walgreens Boots Alliance Inc. Form 10-K for the fiscal year ended August 31, 2023

Websites and Other Publicly Available Sources

- Alphabet Q2 2024 Earnings Call, July 23, 2024, available at https://abc.xyz/assets/bd/7b/d57831684953be8bcc2c5a42aee8/2024-q2-earnings-transcript.pdf, accessed on July 30, 2024
- Financial Accounting Standards Board, "105-10-05: Overview and Background," available at https://asc.fasb.org/1943274/2147479442, accessed on July 23, 2024
- Financial Accounting Standards Board, "About the FASB," available at https://www.fasb.org/facts, accessed on July 23, 2024
- Google, "From the Garage to the Googleplex," available at https://about.google/our-story/, accessed on July 23, 2024
- Google, "How AdSense Works," available at https://support.google.com/adsense/answer/6242051, accessed on July 23, 2024
- Google, "What is Inventory?" available at https://support.google.com/admanager/answer/10064557?hl=en, accessed on July 23, 2024
- IAB Australia, "Executive Briefing: Advertising Technology Purchase Guidelines," March 2018, available at https://iabaustralia.com.au/wp-content/uploads/2018/02/Ad-Tech-Purchase-Guidelines_March-2018.pdf, accessed on July 23, 2024
- Mykola Kryvtsun, "In-App Playbook: How to Get the Most Out of Advertising in Apps?" *Admixer*, May 24, 2021, available at https://blog.admixer.com/admixer-guide-app-advertising/, accessed on July 23, 2024
- Nasdaq, "COMP: Nasdaq Composite: Industry Breakdown," July 23, 2024, available at https://indexes.nasdaqomx.com/Index/Breakdown/COMP, accessed on July 23, 2024
- S&P Dow Jones Indices, "Equity: S&P 500®," June 28, 2024, available at https://www.spglobal.com/spdji/en/idsenhancedfactsheet/file.pdf?calcFrequency=M&

APPENDIX C

force_download=true&hostIdentifier=48190c8c-42c4-46af-8d1a-0cd5db894797&indexId=340, accessed on July 23, 2024

- Sissie Hsaio, "How Our Display Buying Platforms Share Revenue with Publishers," *Google*, June 23, 2020, available at https://blog.google/products/admanager/display-buying-share-revenue-publishers/, accessed on July 23, 2024

- Stephen Morris and Richard Waters, "Alphabet Surges Past $2tn Valuation as Search Giant Announces First Dividend," *Financial Times*, April 26, 2024, available at https://www.ft.com/content/23b4b384-5971-4f91-a9c9-8a779d10b6bc?shareType=nongift, accessed on July 24, 2024

- Thad Baker, "What is Google Display & Video 360?" *Merkle Cardinal Path*, April 28, 2021, available at https://www.cardinalpath.com/blog/what-is-google-display-video-360, accessed on July 23, 2024

- United States Securities and Exchange Commission, "All About Auditors: What Investors Need to Know," June 24, 2002, available at https://www.sec.gov/about/reports-publications/investorpubsaboutauditorshtm accessed on July 24, 2024

- United States Securities and Exchange Commission, "Exchange Act Reporting and Registration," June 24, 2024, available at https://www.sec.gov/resources-small-businesses/going-public/exchange-act-reporting-registration, accessed on July 24, 2024

- United States Securities and Exchange Commission, "Financial Reporting Manual: Topic 1 – Registrant's Financial Statements," November 18, 2020, available at https://www.sec.gov/corpfin/cf-manual/topic-1, accessed on July 24, 2024

* And all other documents cited in my report

APPENDIX D

Cost of Revenue and Gross Profit for Alphabet and DVAA

1. I have been asked by counsel to summarize measures of the cost of revenue and gross profit for Alphabet (and Google) and DVAA for fiscal years 2013 to 2023, to the extent such information is available. I report these amounts in **Tables D1** and **D2** below.

Table D1
Cost of Revenues for Alphabet/Google and DVAA, 2013–2023

in millions	2013	2014	2015	2016	2017
Alphabet/Google[1]	$21,993	$25,691	$28,164	$35,138	$45,583
DVAA[2][3]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

in millions	2018	2019	2020	2021	2022	2023	Total
Alphabet/Google[1]	$59,549	$71,896	$84,732	$110,939	$126,203	$133,332	$743,220
DVAA[2][3]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Source: GOOG-AT-MDL-008927854; GOOG-AT-MDL-008928775; GOOG-AT-MDL-008928776; GOOG-AT-MDL-008928778; GOOG-DOJ-AT-02647833; GOOG-AT-MDL-009709864; GOOG-AT-MDL-C-000018044; Alphabet and Google 2015 10-K; Alphabet 2016 10-K; Alphabet 2017 10-K; Alphabet 2018 10-K; Alphabet 2019 10-K; Alphabet 2020 10-K; Alphabet 2021 10-K; Alphabet 2022 10-K; Alphabet 2023 10-K

Note:
[1] Alphabet/Google Cost of Revenues is as reported on the Consolidated Statements of Income for Alphabet in its Form 10-K filings.
[2] DVAA Cost of Revenues is [redacted]
[3] Alphabet/Google and DVAA Cost of Revenues are not necessarily comparable as these numbers are from two different sources. DVAA numbers are from Go/Ads P&Ls primarily used for internal purposes, whereas Alphabet numbers are from the Company's Form 10-K filings.

APPENDIX D

Table D2
Gross Profit for Alphabet/Google and DVAA, 2013–2023

in millions	2013	2014	2015	2016	2017
Alphabet/Google[1]	$33,526	$40,310	$46,825	$55,134	$65,272
DVAA[2][3]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

in millions	2018	2019	2020	2021	2022	2023	Total
Alphabet/Google[1]	$77,270	$89,961	$97,795	$146,698	$156,633	$174,062	$983,486
DVAA[2][3]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Source: GOOG-AT-MDL-008927854; GOOG-AT-MDL-008928775; GOOG-AT-MDL-008928776; GOOG-AT-MDL-008928778; GOOG-DOJ-AT-02647833; GOOG-AT-MDL-009709864; GOOG-AT-MDL-C-000018044; Alphabet and Google 2015 10-K; Alphabet 2016 10-K; Alphabet 2017 10-K; Alphabet 2018 10-K; Alphabet 2019 10-K; Alphabet 2020 10-K; Alphabet 2021 10-K; Alphabet 2022 10-K; Alphabet 2023 10-K

Note:
[1] Alphabet/Google Gross Profit is calculated as Revenues minus Cost of Revenues as reported on the Consolidated Statements of Income for Alphabet in its Form 10-K filings.
[2] [redacted]
[3] Alphabet/Google and DVAA Gross Profit are not necessarily comparable as these numbers are from two different sources. DVAA numbers are from Go/Ads P&Ls primarily used for internal purposes, whereas Alphabet numbers are from the Company's Form 10-K filings.

2. I present figures for cost of revenue and gross profit for DVAA based on internal company Go/Ads P&Ls. As discussed in Section VI, I understand that, prior to the implementation of the MECE-view, the DVAA product-level P&Ls were prepared using different forms of product-level P&Ls. As such, I deem this approach to be more appropriate given the extended time period that is being summarized. I also note that I am not aware of any Go/Ads P&Ls produced in this matter that include actuals for the fiscal year 2013, which is why these numbers are indicated as N/A in these tables.

EXHIBIT 6

FILED UNDER SEAL

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
SHERMAN DIVISION

THE STATE OF TEXAS, et al.,	§	
	§	
Plaintiffs,	§	
v.	§	Civil Action No. 4:20-cv-00957-SDJ
	§	
GOOGLE LLC,	§	
	§	
Defendant.	§	

EXPERT REPORT OF MARTIN RINARD, PHD

HIGHLY CONFIDENTIAL – SUBJECT TO PROTECTIVE ORDER

I. INTRODUCTION AND SUMMARY OF OPINIONS

A. Qualifications

1. I am currently a tenured Professor in the Department of Electrical Engineering and Computer Science and a member of the Computer Science and Artificial Intelligence Laboratory at the Massachusetts Institute of Technology (MIT). I hold an Sc.B. in Computer Science from Brown University and a Ph.D. in Computer Science from Stanford University. Before coming to MIT, I was an Assistant Professor at the University of California, Santa Barbara (UCSB). During my time at MIT and UCSB, I have taught both undergraduate and graduate computer science courses on a variety of topics including computer systems, data structures and algorithms, compilers, operating systems, software engineering, program analysis, and programming languages. I have published over 175 papers in refereed workshops, conferences, and journals in the areas of programming languages, program analysis, distributed computing, parallel computing, compilers, computer security, mobile computing, and other areas of computer science. According to Google Scholar, as of January 2024, my publications have been referenced over 20,000 times. My h-index of 75, which is a leading measure for quantifying the impact of a scientist's published work, reflects the significant impact of my work in the field of computer science.

2. I have received, among other awards, an Alfred P. Sloan Research Fellowship and a National Science Foundation Early Career Development Award. I have received multiple Best or Distinguished paper awards at top publication venues, including "One of 25 Most Significant Papers from First 20 Years of IEEE International Symposium On Field-Programmable Custom Computing Machines" and the "Most Influential Paper in 20 Years Award, Area: Concurrent Constraint Programming" from The Association for Logic Programming. In 2009 I was recognized as an ACM Fellow by the Association for Computing Machinery (ACM).

3. My research has been supported by many entities, including the United States National Science Foundation, the United States Department of Defense (including the Defense Advanced Research Projects Agency), the government of Singapore, the NASA Jet Propulsion Laboratory (JPL), as well as private entities such as SUN Microsystems, Microsoft, Samsung, Boeing, and IBM.

4. Before starting graduate school, I worked as a software engineer at two startup companies, Ikan Systems and Polygen Corporation. At Ikan Systems my responsibilities involved user interface design and implementation as well as programming language design and implementation. At Polygen Corporation my responsibilities involved a variety of tasks, including developing software to work with computerized representations of molecules and user interface implementation.

5. I have extensive experience in software analysis in both my academic research and my experience serving as an expert witness (as detailed in my CV, Appendix A).

6. My academic research has involved the development and evaluation of automated systems for analyzing software systems as well as manual source code analysis. In Paragraphs 7-10 below, I describe illustrative examples of my research and publications in this area.

7. The research presented in the paper *Enhancing Server Availability and Security Through Failure-Oblivious Computing*, by M. C. Rinard, C. Cadar, D. Dumitran, D. M. Roy, T. Leu, W. S. Beebee, involved manual analyses of the source code of different programs to determine the root cause of software defects and the resulting effect of the proposed techniques on enabling software systems to continue to execute despite the presence of otherwise fatal software errors. These analyses involved tracing the flow of control and data through the source code after the activation of these techniques to understand the effect of the techniques on the overall execution.

8. The research presented in the paper *Detecting and Escaping Infinite Loops with Jolt*, by M. Carbin, S. Misailovic, M. Kling, M. C. Rinard, involved manual analyses of the source code of different programs to determine the effect of techniques that detected and escaped infinite loops triggered by different inputs to these programs. These analyses involved tracing the flow of control and data through the source code after the activation of these techniques to understand the effect of the techniques on the overall execution after the infinite loop.

9. The paper *Sound Input Filter Generation for Integer Overflow Errors* by F. Long, S. Sidiroglou-Douskos, D. Kim, M. C. Rinard, involved an automated program analysis to derive symbolic expressions over input fields that represent the computation of expressions that control the sizes of allocated or copied memory blocks. These expressions are used to derive input filters that

detect and discard inputs that may trigger integer overflow errors in the computation of these expressions.

10. The paper *Analysis of Multithreaded Programs*, by M. C. Rinard, surveyed a range of algorithms for automatically analyzing multithreaded programs (programs that execute parts of the program in parallel) in support of various goals such as improving the performance of the analyzed programs and ensuring the absence of classes of software defects such as data races and deadlocks.

11. I was recently invited to give a keynote at the 2024 International Conference on Software Engineering, "the premier software engineering conference, providing a forum for researchers, practitioners and educators to present and discuss the most recent innovations, trends, experiences and concerns in the field of software engineering."[1]

12. In sum, I have over 35 years of experience in research and development in the areas of computer science as a researcher, professor, and consultant.

B. Assignment

13. In connection with *Texas v. Google LLC*, No. 4:20-cv-957-SDJ (E.D. Tex.) (the "Action"), I have been asked by counsel for Google to evaluate and provide my opinions, as an independent technical expert, on:

    a. The use of source code by Plaintiffs' expert Dr. Jacob Hochstetler in his report dated June 7, 2024 ("Hochstetler Report"),

    b. An evaluation of certain claims of Plaintiffs' expert Dr. Joshua Gans in his report dated June 7, 2024 ("Gans Report") regarding the operation of Project Bernanke and Global Bernanke (which are Google Ads bid optimizations), based on my analysis of Google's produced source code,

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[1] *See* International Conference on Software Engineering, ICSE Home Page, http://www.icse-conferences.org, ("ICSE, the International Conference on Software Engineering,® is the premier software engineering conference, providing a forum for researchers, practitioners and educators to present and discuss the most recent innovations, trends, experiences and concerns in the field of software engineering."); Keynotes - ICSE 2024, https://conf.researchr.org/attending/icse-2024/keynotes (listing me as a keynote speaker).

c. Project Bell v.2, a further optimization of Project Bernanke which was adopted by Google in response to so-called "multi-calling" activities undertaken by publishers, including an analysis of Google's produced source code relevant to Project Bell v.2, and

d. An evaluation of certain claims of Professor Gans regarding the operation of Google Ad Manager's Dynamic Revenue Sharing ("DRS") program based on my analysis of Google's produced source code.

14. I am being compensated for my work on this case at my standard expert witness rate of $975 per hour. My compensation for this assignment is not contingent upon the results of my analysis, the opinions I express, the substance of any testimony I may give, nor the outcome of this case. I confirm that I have no conflict of interest of any kind and that this report reflects my own independent views.

C. Methodology

15. In forming my opinions, I have reviewed the Hochstetler Report, the Gans Report, source code produced by Google,[2] and produced documentation and data. I have also relied on my expertise, research, and industry knowledge in computer science and software engineering.

16. A list of materials that I have relied on in preparing this report is provided in Appendix B. I may review additional evidence relevant to my opinions as I continue my work. I reserve the right to supplement or amend this report if my opinions change as the result of analyzing new evidence or if I am presented with additional expert opinions.

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[2] Throughout this report, files beginning with "GOOGEDTX-SC-" reference Google's actual source code files (or portions thereof) as produced to the Plaintiffs in connection with this litigation pursuant to the Source Code Protocol in Appendix B of the Protective Order entered by the Court on December 13, 2023. *See* Confidentiality Order, ECF 182, *The State of Texas, et. al. v. Google, LLC,* 4:20-cv-00957 (E.D. Tex.). Likewise, references to source code "snapshots" (e.g. "1/2017 snapshot") refer to a set of Google's source code as it existed at a specified point in time (in this example, January 2017), which I understand were also made available to the Plaintiffs pursuant to the Source Code Protocol. In connection with my assignment in this Action, I have reviewed only source code that I understand was also made available to the Plaintiffs.

D. Summary of Opinions

17. **Professor Hochstetler's opinions do not appear to be grounded in substantive source code analysis.** To qualify as a substantive source code analysis describing the operation of a software system, the analysis should include a careful review of the relevant source code which takes into account how it functions in context. While reviewing documents and code comments can (and often should) inform the analysis, the result should not be described as a substantive "source code analysis" if documents or comments are the principal sources of the analysis.

18. The body of the Hochstetler Report consists almost entirely of a summary of Google's internal documents. Reviewing technical documentation is one methodology for understanding the behavior and operation of a software system. However, without more, that is not a substantive source code analysis. And, in the absence of substantive source code analysis, the expert is not in a position to go beyond what the documents themselves say or to identify any deviations between the documented and actual behavior of the system.

19. Professor Hochstetler's Appendix C does not contain the substantive analysis that would be required to actually establish relevant aspects of the operation of the Google systems at issue in this case. My own analysis of the produced Google code, meanwhile, suggests that understanding the operation of a single feature frequently requires tracing the interaction of multiple methods, often across multiple files. Given that, while Appendix C may support an inference that Professor Hochstetler or his team reviewed some portions of Google's source code, it does not provide a substantive source-code-based analysis that can substantiate the opinions he offers in his report.

20. **Google engineers identified an** [redacted] Citing a document out of context, Plaintiffs' expert Professor Gans claims that Google's Global Bernanke program "overcharged advertisers."[3] The notes by Google engineers in the cited document identified an [redacted]. In

[3] Gans Report, ¶ 772-773 ("Bernanke overcharged advertisers. An internal document describing Global Bernanke notes that [redacted]").

response, Google promptly updated the software to remedy the unanticipated behavior, which is consistent with good software engineering practice.

21. In addition, during the operation of the Google Ad Tech system, Google observed publishers repeatedly submitting ad slot inventory multiple times with different prices to "fish" for high bids. Google responded to this "multi-calling" behavior by implementing Project Bell v.2, which included a technique designed to identify publishers engaging in "multi-calling" behavior.[4,5] Google deactivated the Bernanke subsidy mechanism for impressions from publishers engaging in this "multi-calling" behavior.[6]

22. **Professor Gans mischaracterizes the operation of Google Ad Manager's Dynamic Revenue Sharing ("DRS") feature, implying that it overcharged publishers by increasing Google's sell-side revenue share. This mischaracterization is inconsistent with both Google's design documentation and my source code analysis of DRS v.1 and v.2.** The Gans Report not only mischaracterizes DRS as overcharging publishers, but is in fact in disagreement with Plaintiffs' own expert, Professor Hochstetler, who correctly states that DRS v.1 only ever reduced Google's

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[4] GOOG-AT-MDL-008842383 (Declaration of Nirmal Jayaram), at ¶¶ 11-13 ("Under Bell v.2, Google Ads would modify its bidding behavior (to decrease bid variance) when receiving multiple calls for the same ad request to protect advertisers from the risk of price inflation…Some publishers would call an ad exchange, such as AdX, multiple times for the same potential ad opportunity. For simplicity, I will refer to this practice as 'multi-calling.' [...] Some publishers employing multi-calls would set a different floor price for each of the multiple calls made from a single ad exchange for the same potential ad opportunity. For example, a publisher could configure an AdX call with a floor price of $5 for a potential ad opportunity and a second AdX call with a floor price of $4.50 for the same potential ad opportunity…"). *See also* GOOG-DOJ-AT-02471119, at -120 ("About [redacted] of the domains on Adx fall in this category.").

[5] *See, e.g.*, Seb Joseph, "DSPs are cracking down on bid duplication," Digiday (May 12, 2020), https://digiday.com/media/dsps-are-cracking-down-on-bid-duplication ("Traffic spikes have caused increased costs in processing bid requests, giving already under pressure demand-side platforms extra economic incentive to squash bid duplication. MediaMath is building a new supply chain that doesn't include SSPs that sell duplicated impressions, for example. Last month, The Trade Desk gave all the SSPs it buys impressions from two weeks to stop sending it duplicated requests to take part in the same auction."); Sarah Sluis, "The Trade Desk suppresses bid duplication amid COVID-19 traffic surge," AdExchanger (Apr. 21, 2020), https://www.adexchanger.com/platforms/the-trade-desk-suppresses-bid-duplication-amid-covid-19-traffic-surge ("Publishers that slot the same six exchanges into multiple header-bidding auctions, such as Prebid, Google open bidding and Amazon Transparent Ad Marketplace, send 18 identical bid requests for the same piece of inventory to The Trade Desk. Currently, DSPs often begrudgingly evaluate them all, and find it hard to tell if the impression is exactly the same.").

[6] GOOG-AT-MDL-008842383 (Declaration of Nirmal Jayaram), at ¶ 17 ("Bell v.2 changed Google Ads' bidding behavior for multi-calling publishers as follows: (1) Google Ads disabled Bemanke when bidding on multi-calling publishers' inventory…").

sell-side revenue share (typically 20%) and never increased it.[7] Moreover, my own source code analysis shows that neither DRS v.1 nor DRS v.2 increased Google's sell-side revenue share for any publisher relative to the pre-DRS status quo. Specifically, DRS v.1 always produces a revenue share for each publisher that is at least as large as the non-DRS revenue share for the publisher. DRS v.2 also produces an aggregate revenue share for each publisher that is at least as large as the non-DRS revenue share for the publisher. With each of DRS v.1 and DRS v.2, each publisher therefore receives an aggregate revenue share that is at least as large as the publisher would receive without DRS v.1 or DRS v.2.

II. PROFESSOR HOCHSTETLER'S CONCLUSIONS, AS DESCRIBED IN HIS REPORT, DO NOT APPEAR TO BE BASED ON SUBSTANTIVE SOURCE CODE ANALYSIS

A. Methods of Analyzing Software Systems

23. There are a variety of different ways to understand the behavior and operation of a software system, including by analyzing relevant source code, reviewing relevant documentation, interviewing engineers knowledgeable about its creation, or simply observing its behavior in response to particular inputs. Each of those distinct methods has its strengths and weaknesses, and each may, in appropriate circumstances, be a reliable approach.

24. To qualify as a substantive source code analysis describing the operation of a software system, however, the analysis should include a careful review of the relevant source code, taking into account how it functions in context. Reading comments or documentation where available can (and often should) inform that analysis, but if they are the principal sources for the analysis or form a substitute for reading the code itself, the result should not be described as a substantive source code analysis (even if the comments themselves are contained within source code files).

25. Similarly, it is important to evaluate source code in an appropriate context. It is rarely possible to draw a definitive conclusion from a single line of code (or even a handful of such lines) in

[7] See Hochstetler Report, ¶ 262 ("The first version of DRS was launched in 2015 and only lowered AdX's revenue share, never raising it as in future versions of DRS."). *See also, e.g.*, GOOG-DOJ-03620221 at -222 [redacted] GOOG-DOJ-13199952 at -954 ("[redacted] GOOG-DOJ-15193608 at -608 [redacted]

isolation, without an understanding of how they are actually used in the system. That can be particularly true when the code is simply an assignment of a value to a variable or the invocation of a function with a particular name.

26. As a hypothetical example, if a codebase were to contain a function named apply_discount() that was invoked with the value 0.1, that would not be sufficient, by itself, to demonstrate that the system applied a 10% discount. Rather, a substantive source code analysis would typically seek to understand, for example, where the apply_discount() function was invoked in the code, how it was applied to the calculation of the final price, and which customers it applied to.

27. Likewise, the fact a variable named max_price is set to the value 100 does not necessarily establish that the system will never charge a customer more than $100. A substantive source code analysis seeking to establish that fact would also need to include at least some review of how that variable is actually used. For example, perhaps the code that later reads the value to update the customer's account interprets it in cents, rather than dollars. Or perhaps, before the value is actually used, another assignment changes the value to 75 or 125. Or perhaps the variable is never actually read or used at all by the rest of the system.

28. That does not imply that one must analyze the entire source code of a system to understand its behavior. If, for example, max_price is a local variable (i.e., a variable that is only accessible by other code in the same method), it might well suffice to review that method to understand if and how it is used. Or if it is part of a larger data structure, one might review a set of methods that operate on that data structure. The specific methodology may vary depending on the specific goal of the analysis, but a reliable substantive source code analysis will typically describe the code that was reviewed and provide a basis for believing that code analysis was sufficient to answer the question at hand.

B. The Hochstetler Report Is a Summary of Google's Internal Documents

29. As part of my preparation for this report, I reviewed the Hochstetler Report, including Appendix C thereto, which purports to describe Professor Hochstetler's source code analysis.

30. While I have no reason to doubt Professor Hochstetler's assertion that he reviewed Google source code in the course of his engagement, I do not see evidence in the Hochstetler Report establishing that his substantive conclusions were based on that review.

31. Rather, the discussion of Google's ad tech system in the body of the Hochstetler Report (excluding Appendix C, which I discuss separately below) consists almost entirely of a summary of Google's internal documents. There is no substantive discussion in the body of the Report of Google's produced source code—only high-level cross-references to Appendix C (which, as discussed below, does not demonstrate a substantive source code analysis)—and no indication in the body of the Report or Appendix C that his substantive conclusions are drawn from an analysis of that code.

32. As noted above, reviewing documentation is one methodology for understanding the behavior and operation of a software system. However, in the absence of substantive source code analysis, the expert is not in a position to go beyond what the documentation says or to identify deviations between the documented behavior and the actual behavior of the system based on the operational code.

33. In the absence of a substantive source code analysis, outside experts reviewing technical documentation can inadvertently misinterpret the documents, for example either because they misunderstood the context in which they were originally written, because the actual behavior of the system changed after the documents were written, because the functionality described in the documents was never implemented, or because the documents do not accurately describe the functionality. There are, in turn, a number of ways to mitigate that risk, including conversations with (or, in a litigation context, the review of testimony by) engineers who are more familiar with the underlying code.

34. As a result, and based on my professional expertise and experience with prior code reviews, I consider it entirely possible, and perhaps probable, that there are points in Professor Hochstetler's report where his descriptions based on his review of Google documents differ to varying degrees from the actual operation of Google's systems at the relevant points of time. However, since my assignment for this case was to review his purported use of *source code* to support the conclusions in his report, and not to review his analysis of Google documents, I have

not attempted to identify all such differences or offer an opinion on the degree to which those differences lead to materially different conclusions in the context of this case.

C. Appendix C to the Hochstetler Report Provides Superficial References to Google's Produced Source Code, But Does Not Demonstrate a Substantive Source Code Analysis

35. Appendix C to the Hochstetler Report provides what Professor Hochstetler offers as a summary of his purported "source code review findings" in this case. Appendix C, however, does not contain the substantive analysis that would be required to actually establish the operation of the Google systems at issue in this case. The purported "source code review findings" therefore add little, if anything, to Professor Hochstetler's document-based conclusions in the body of his report, which I discussed in the previous section.

36. Appendix C opens with some background information about the code made available for review, including that it contained 926,604 files over 11 snapshots, amounting to 73.9 gigabytes in total.

37. I take that to be an indication of the size of Google's total code production in connection with the Action, not an indication of the amount of code actually reviewed by Professor Hochstetler, as it would be implausible for one person (or even a small team of reviewers working under one person's supervision) to actually read and understand that much code for a system as complex as Google's ad tech products. If Professor Hochstetler *were* claiming to have reviewed all of that code, I would expect much of that review to be superficial at best.

38. I also note that Professor Hochstetler does not provide any description of his methodology for calculating the "number of change logs," "number of related files," and "number of authors" shown in the table on page 2 of Appendix C.[8]

39. The remainder of Appendix C to the Hochstetler Report consists of a series of 32 short sections purporting to describe aspects of Google's code, including the names of purportedly relevant files, methods, variables, and data structures.

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8 *See* Hochstetler Report Appendix C at page 2.

40. Appendix C does not, for example, demonstrate how the methods it identifies interact with each other or the relevant data structures, or even establish that they are used at all. Instead, they are largely assertions by Professor Hochstetler without underlying citations or support.

41. Given that, while Appendix C might support an inference that Professor Hochstetler or his team reviewed some of Google's source code, it does not provide code-based substantiation for the substantive conclusions he offers in his report.

42. As just one illustrative example of this point, consider some of the deficiencies in the first of Professor Hochstetler's mini-sections (Section B.1 entitled "Backfill Type and Call Flow").

43. That section makes a number of statements purporting to describe certain aspects of how portions of Google's systems interact. For example:

   a. [redacted]

[redacted]

[redacted]

[redacted]

44. Nothing in Appendix C identifies specific functions that perform any of those calls, or code paths showing where (or that) they are called.

45. Section B.1 does identify two functions, specifically [redacted] *and* [redacted] However, the Appendix does not identify any code that invokes these functions, does not identify any code that these functions invoke, cites no code that would indicate that these functions ever execute, and cites no code that would provide any evidence that these functions play the roles that Professor Hochstetler claims they play.

46. Turning to Section B.2 (entitled "[redacted]"), Professor Hochstetler asserts that his examination of a particular source code file named [redacted] "verified [his] analysis in [his] report that the [redacted]," citing Section VI.B of the main body of his report.

47. The balance of that section consists of two paragraphs providing examples of how the [redacted] data structure was used in various portions of Google's code. They do not, however, identify the context in which those methods were invoked, or show how it was "[redacted]."

48. Indeed, those two paragraphs leave open more questions than they answer. For example, Professor Hochstetler identifies the relevant field in which the floor price is stored as being named [redacted] which he claims is stored in a function [redacted]. Yet, based on my analysis of that method, neither it, nor any other method in the same source code file as that method, actually references the [redacted].

49. Nor does the Appendix present an analysis of any code that establishes what role, if any, [redacted] plays in any computation. Indeed, the Hochstetler Appendix presents no evidence that [redacted] is ever invoked in any computation.

50. Because Professor Hochstetler does not describe his methodology or reasons for believing the claims in Sections B.1 and B.2 (and other claims in Appendix C) are true, I am not able to determine whether these claims are based on a substantive or superficial review of source code, nor whether his or his team's source code review was flawed or valid. For my part, all that I can review or respond to is the source code analysis that is actually contained in Appendix C, which does not provide enough substantive information to demonstrate the operation of Google's systems to any level of reasonable certainty.

III. PROFESSOR GANS MISCHARACTERIZES GOOGLE ADS' "BERNANKE" BID OPTIMIZATION

51. Professor Joshua Gans, one of Plaintiffs' economic experts, asserts that Project Bernanke, a bid optimization introduced into Google Ads in 2013 and subsequently refined through at least 2018, was anticompetitive and harmed Google's customers.[9]

52. While I do not offer any opinion on the economic effects of Project Bernanke (including whether it is procompetitive or anticompetitive), my analysis of Google's produced source code does show that Professor Gans mischaracterized the operation of Project Bernanke in important ways that could undermine his purported economic conclusions.

53. In particular, Professor Gans appears to have misunderstood or failed to account for the fact that Google Ads applies any Bernanke adjustments to the bids that it submits to the AdX auction *before* it submits those bids to the AdX auction, without any knowledge of or influence from any other bids submitted into the AdX auction.[10] Indeed, my source code analysis shows that Google Ads determined the magnitude of the Bernanke adjustments that would be applied in advance (if Bernanke were to be applied at all), before the live AdX auction code even considered any particular bid request.

54. Professor Gans similarly ignores important principles of software engineering when he asserts that Global Bernanke (the second major iteration of Google Ads' Bernanke functionality) "overcharged advertisers."[11] That assertion is apparently based on a document which, when read in the appropriate context, actually shows a diligent effort by Google to correct an unexpected

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9 Gans Report, ¶ 19 at n.3 ("My analysis and opinions in this report show that Google engaged in the following anticompetitive conduct, which I understand underlie the Plaintiff States' penalty requests:…Bernanke..."); Gans Report, ¶¶ 737-775 (discussing how Bernanke allegedly harmed competition in the buying market for ad buying tools for small advertisers, harmed publishers by reducing the effectiveness of monetization of their inventory, and harmed advertisers by overcharging them in low-demand auctions).

10 *See, e.g.*, GOOG-AT-MDL-008842383 [redacted] GOOG-DOJ-13469175, at -175 [redacted]

11 Gans Report, ¶ 772 ("Bernanke overcharged advertisers.").

interaction between Bernanke and other aspects of Google Ads's bidding architecture, consistent with accepted good practice in the software engineering industry to identify and remedy so-called "bugs" that are widely recognized as a near inevitability in complex software systems.

55. I discuss each of those issues in turn, and then describe an additional example of Google's efforts to adjust Bernanke to respond to unexpected or unwanted behavior with another optimization known as "Project Bell v. 2."

A. Google Ads Applies Project Bernanke Before Any Bids Are Submitted to the AdX Auction and Without Regard to Any Other Bids Submitted to the AdX Auction

56. Project Bernanke's bid adjustment does not use any information from other bids in the auction and applies to the bid before it is submitted to the AdX auction.[12]

57. One of Google Ads' key functions is to determine what bids to submit on behalf of its advertisers when it receives bid requests from ad exchanges, including Google Ad Manager (AdX).

58. Project Bernanke is one of the optimization algorithms that Google Ads uses as part of that overall process of determining a final bid. As described in Google's internal documents,[13] Bernanke's objective is to help Google Ads advertisers win more AdX auctions by bidding higher when Google Ads predicts other bids will be high and lower when Google Ads predicts other bids will be low.

[12] *See* GOOG-DOJ-13469175, at -175 [redacted]

[13] *See e.g.,* GOOG-DOJ-12700489 at -491 [redacted] ; GOOG-DOJ-13469175, at -176 [redacted]

59. Contrary to Professor Gans' assertion that "[w]hen a non-GDN buying tool offers the highest bid [in an AdX auction], Bernanke kicks in to inflate the Google bid,"[14] my source code analysis demonstrates that Google Ads determines whether to apply Bernanke and, if so, how much of an adjustment to apply, before it submits a bid into the AdX auction, just as any other buyside tool could do before it submits its bid. Those decisions are made without any knowledge of what bids other buying tools may or may not have submitted to the AdX auction, let alone whether a "non-GDN buying tool" (by which I understand Professor Gans to refer to a competitor of Google Ads) had the "highest" such bid.

60. I provide a detailed analysis of the relevant portions of Bernanke's source code in Technical Appendix §I., but at a high level, the key conclusions are as follows:

a. [redacted]

b. When subsequently processing a bid request, Google Ads determines whether to apply Bernanke to that auction based on a number of factors, none of which depend on what other bids may have been submitted to that AdX auction. (One of those factors, known as Bell v.2, prevents Bernanke from applying to publishers that Google believes are engaged in "multi-calling" behavior and is discussed in more detail below.)

c. [redacted]

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[14] Gans Report ¶ 743 ("When a non-GDN buying tool offers the highest bid, Bernanke kicks in to inflate the Google bid.").

[15] See GOOGEDTX-SC-00041 ([redacted]) (1/15/2017 snapshot) and GOOGEDTX-SC-00042 [redacted]) (1/15/2017 snapshot). See also generally the other [redacted] files with references to "[redacted] in their filenames in [redacted] 1/15/2017 snapshot) as listed in GOOGEDTX-SC-00043 ([redacted] at lines 5-19. These referenced [redacted] files are similarly executed [redacted]

[redacted].

B. Professor Gans Relies On A Document Taken Out Of Context To Conclude That Bernanke "Overcharged Advertisers"

61. Professor Gans also asserts that Bernanke "overcharged advertisers" in what he describes as low-demand auctions.[16] In support of this claim, he cites a document[17] which he apparently misunderstood.

62. Far from showing an intentional or widespread practice, I read the document, from a computer science perspective, as indicating Google's engineers recognizing [redacted] and developing a plan to update the system to rectify the situation. Identifying and remedying these sorts of "bugs" is common practice in the development of complex software systems.

63. No complex software system will ever be entirely free of "bugs." It is generally accepted in computer science and software engineering that bugs in code are a near inevitability, for reasons ranging from human error to the difficulty in predicting the precise interactions of complex systems that are constantly evolving over time. The key is to have processes in place for identifying, triaging, and fixing them.[18] Google is no exception to this industry reality. The fact that some bugs may nonetheless remain does not detract from the overall quality of the software system and its ability to productively serve the needs of its users and clients.

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[16] Gans Report, ¶ 772-773. ("Bernanke overcharged advertisers. An internal document describing Global Bernanke notes that [redacted]").

[17] See GOOG-DOJ-15472232, at -302. [redacted]

[18] The evidence I have reviewed in connection with this Action indicates that Google has extensive testing infrastructure and uses a robust approach consistent with industry practice to identify, triage, and fix bugs and ensure that its software operates acceptably in practice. By way of illustrative example, Google has developed [redacted]

64. With respect to the document Professor Gans relies on to support his assertion, my analysis of the document and changelogs produced in this Action indicates that Google engineers quickly identified a bug—[redacted]—and worked to resolve it expeditiously and carefully.

65. As noted above, bugs and unexpected interactions in code are a near inevitability. Good software engineering practice includes discovering unexpected interactions and other issues, then fixing these as appropriate in a timely and non-disruptive manner. Based on the evidence I have reviewed, my opinion from a computer science perspective is that the actions of Google engineers in this situation are consistent with this sort of good practice.

i. Google Engineers Discovered [redacted]

66. Professor Gans's principal citation in support of his broad claim that "Bernanke overcharged advertisers"[19] is a document describing an apparent technical issue involving Global Bernanke. Professor Gans offers no opinion as to whether the cited issue was a persistent phenomenon. He does not provide any estimate of the number of customers affected nor any estimate of the magnitude of the cited issue's effects.

67. The key document that Professor Gans cites is a collection of meeting notes from approximately 2015 to 2017.[20] These notes contain a few bullet points dated [redacted]" The notes provide little other context to pinpoint the exact detected issue in Global Bernanke.[21]

68. Based on the evidence I have reviewed, it appears that Professor Gans fails to understand the full context from which this information was taken: a Google engineering description of the impact of an [redacted]

[19] See Gans Report, ¶ 772. ("Bernanke overcharged advertisers. [redacted]").

[20] The document contains very few references to years; the meeting dates are mostly only recorded on a month and day basis. The entries primarily refer to the years 2015, 2016, and 2017. *See generally* GOOG-DOJ-15472232.

[21] *See generally* GOOG-DOJ-15472232 at -302.

[redacted]

ii. My Source Code Analysis Shows that Google Engineers Worked to Fix the Unexpected Behavior

69. The meeting notes that Professor Gans cites are dated March 29 without specifying a year.[22] An examination of the notes document indicates that the notes are arranged in reverse chronological order, i.e. the most recent notes are at the top of the document. For example, there is an entry titled [redacted][23] that indicates the year 2016 (unlike the majority of entries that do not specify years), with an entry for "Jun 27th" below it (closer to the end of the document), and an entry for "Jun 29th" above it (closer to the top of the document). This property holds throughout the document for other entries as well,[24] suggesting that the document is in reverse chronological order.. Walking through the list of entries in the document as a whole suggests that the notes that Professor Gans references are from March 29, 2016.

70. However, in my opinion, the language in the notes implies that [redacted] One bullet point states that Google was [redacted]"[25] A second bullet point identifies a [redacted]"[26] The notes also imply that Google intended to test and fix this issue quickly, stating [redacted] referencing the RASTA[27] experiment analysis software.[28]

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22 GOOG-DOJ-15472232 at -302. ("Global Bernanke tuning - March 29th.").

23 *See* GOOG-DOJ-15472232 at -276.

24 An "[redacted]" entry dated to "Jan 6th 2015" (see GOOG-DOJ-15472232 at -484) is immediately preceded by a header stating "2014," which itself is immediately preceded by an entry "Dec 15th" (suggesting December 15th, 2014). The entries above the "Jan 6th 2015" entry specify dates of "Jan 7th," and proceeding higher in the document yields more recent dates: "Jan 8th," "Jan 9th," and so on (*see generally* at -478-483).

25 GOOG-DOJ-15472232 at -302 [redacted]

26 GOOG-DOJ-15472232 at -302 [redacted].

27 GOOG-AT-MDL-004017319 at -323. ("Reliable A/B Stats Tracking Architecture: RASTA is the tool for analyzing experiments.").

28 GOOG-DOJ-15472232 at -302.

71. Google's produced changelogs detail the launch of this solution. [redacted] [redacted] [redacted]."[30]

72. The changelogs[31] within Google's codebase demonstrate that Google identified this [redacted].

73. [redacted] [redacted].[34] Based on my analysis, this evidence indicates actions by Google engineers to resolve the identified bug and bring the system closer to its intended design in a timely fashion. These actions are consistent with sound software engineering practice.

C. With Project Bell v.2, Google Also Adjusted the Application of Project Bernanke to Protect Against Exploitation by "Multi-Calling"

74. Another example of Google's efforts to monitor the operation of its systems and respond to their observed behavior is a change known as "Project Bell v.2."

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29 See [redacted] (4/29/2016) [redacted] [redacted] …").

30 See [redacted] (4/6/2016) ("[redacted] …").

31 In computer science and engineering, a changelog (or change log) refers to a record (log) of the modifications made to files or data in general, usually labeled with metadata such as when the changes were made, by whom, and with comments explaining them. Here, Google's produced changelogs are traceable records of modifications to Google's source code.

32 I limited the scope of my search to between the months of March and May in the years 2015, 2016, and 2017 due to the date on the meeting notes identified by Professor Gans.

33 See GOOGEDTX-SC-00003 ([redacted]) (4/29/2016) ("… [redacted]

34 See GOOGEDTX-SC-00004 ([redacted]) (4/6/2016) ("[redacted] …").

75. As described above, at a high level, Bernanke and its variants were designed to help Google Ads advertisers win more AdX auctions by bidding higher when Google Ads predicts other bids will be high and bidding lower when Google Ads predicts other bids will be low.[35]

76. By doing so, Bernanke sought to win more impressions for Google Ads' advertisers while keeping Google Ads' overall margin consistent.[36] As Google's documents[37] reflect, however, a bidding system with higher variance among bids (such as Bernanke) can potentially be exploited by calling it multiple times to "fish" for higher bids, which as my source code analysis shows, is referred to as "multi-calling" or "daisy chaining"[38] in Google's source code. Project Bell v.2 was an effort by Google to respond to this "multi-calling" or "daisy chaining" behavior.

i. Overview of Project Bell v.2

77. Identifying and mitigating undesirable system behavior, including behavior triggered by specific user actions, is often part of the role of a software engineer. Project Bell v.2 was an addition to Global Bernanke that sought to identify multi-calling publishers who were sending multiple calls to Google's ad exchange (AdX) to "fish" for the highest payout for the offered inventory. Bell v.2 identified those publishers using an algorithm that evaluated the number of queries AdX

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35 GOOG-DOJ-13469175, at -176 ("[redacted]

36 GOOG-DOJ-14952787, at -787 [redacted].

37 GOOG-AT-MDL-008842383 (Declaration of Nirmal Jayaram), at ¶¶ 11-13 ("Under Bell v.2, Google Ads would modify its bidding behavior (to decrease bid variance) when receiving multiple calls for the same ad request to protect advertisers from the risk of price inflation…Some publishers would call an ad exchange, such as AdX, multiple times for the same potential ad opportunity. For simplicity, I will refer to this practice as 'multi-calling.' [...] Some publishers employing multi-calls would set a different floor price for each of the multiple calls made from a single ad exchange for the same potential ad opportunity. For example, a publisher could configure an AdX call with a floor price of $5 for a potential ad opportunity and a second AdX call with a floor price of $4.50 for the same potential ad opportunity…"). *See also* GOOG-DOJ-AT-02471119, at -120 ("About [redacted] of the domains on Adx fall in this category.").

38 Daisy chaining in the context of multi-calling publishers "fishing" for higher bids should not be confused with daisy chaining in reference to "waterfalling," which I understand to be a completely separate concept in the advertising industry.

would receive from a given publisher under various experimental conditions to derive a test that would distinguish multi-calling publishers.

78. This test was based on a [redacted] for multi-calling publishers, but would be [redacted] for publishers that were not calling AdX multiple times for a given impression. My analysis shows that publishers that "failed" this test were added to a [redacted] for which Bernanke was disabled (and therefore whose bids would not be subsidized by the Bernanke mechanism).

ii. Project Bell v.2 Source Code Analysis

79. In my analysis, I constructed a "traceback" (or "stack trace" or "call chain") to determine Project Bell v.2's functionality. Generally speaking, this approach follows the execution of software to identify a relevant chain of function calls that originate from or lead to a specific designated point of interest. Such a construction can often provide context that helps to identify the role that the code plays in the computation, as well as the relationship of that code to other code it relies on and code that relies on it. I used this method to help identify the quantities that the code computes and the sources of information that it leverages to do so.

80. More specifically, my analysis proceeded as follows (see Technical Appendix §I. for additional detail). Working with the 1/15/2017 source code snapshot (the first source code snapshot after the October 2016 launch of Bell v.2 produced pursuant to the Source Code Protocol),[39] I identified the location in the source code where the code applied the Bernanke multipliers ([redacted] in GOOGEDTX-SC-00014 and invoked functions). Starting with code that initiates the bid pricing process ([redacted]),[40] I traced the execution from this code to the code that applies the Bernanke multipliers (see Technical Appendix §I.A).

39 See GOOG-AT-MDL-008842383 (Jayaram Declaration), at ¶ 11 ("Global Bemanke was subsequently updated in October 2016. This update, relating to the detection and management of multiple calls, was sometimes referred to internally as 'Bell v.2.' Under Bell v.2, Google Ads would modify its bidding behavior (to decrease bid variance) when receiving multiple calls for the same ad request to protect advertisers from the risk of price inflation.").

40 See GOOGEDTX-SC-00015 ([redacted]) (1/15/2017 snapshot).

81. The code that applies the Bernanke multipliers [redacted] For convenience I will refer to this implementation as the "Bernanke multiplier" mechanism [redacted].

82. Along this code trace, I identified several conditions that turned off the Bernanke multiplier mechanism and therefore turned off any bid subsidy in the auction. One of these conditions turns off the Bernanke multipliers if the publisher domain is [redacted].[41]

83. I next identified the code that generates the [redacted]. This code is located in the file [redacted]. I analyzed this code and related code in [redacted][42] and [redacted][43] to determine how the code decides to [redacted] See Technical Appendix §I.F.

84. This determination is based on data from [redacted] (so-called "multi-call publishers," as explained above).

85. The goal of the experiments is to detect publishers that repeatedly submit calls with descending floor prices to "fish" for the highest bid. [redacted].

86. In the situation where a publisher is engaging in "multi-call" behavior:

41 See GOOGEDTX-SC-00014 ([redacted]) (1/15/2017 snapshot).

42 See GOOGEDTX-SC-00020 ([redacted]) (1/15/2017 snapshot).

43 See GOOGEDTX-SC-00019 ([redacted]) (1/15/2017 snapshot).

a. [redacted].

b. [redacted]

87. Therefore, if the publisher is engaging in "multi-call" behavior, the [redacted]

88. The code that determines whether to place a publisher on the [redacted] whose bids are not subsidized by Bernanke [redacted][44]

89. Using the code trace, I also identified several other conditions in which Google Ads does not subsidize bids by Bernanke.

90. Finally, I identified the code that generates the Bernanke multipliers used in online auctions ([redacted]).[45] This code executes [redacted]

91. My analysis of the code that generates the Bernanke multipliers indicates that this code can [redacted]. [redacted]

44 See GOOGEDTX-SC-00020 ([redacted]) (1/15/2017 snapshot) , GOOGEDTX-SC-00019 ([redacted]) (1/15/2017 snapshot), and GOOGEDTX-SC-00018 ([redacted]) (1/15/2017 snapshot). *See also* Technical Appendix §I.F.

45 See GOOGEDTX-SC-00021 ([redacted]) (1/15/2017 snapshot).

92. The conclusion of my source code analysis for Project Bell v.2 is that it is an illustrative example of how Google engineers identified a way in which publishers were exploiting Bernanke, planned a way to detect this undesirable system behavior, and implemented a remedy that would disallow these publishers from "fishing" for higher auction prices through their "multi-calling" tactics.

IV. PROFESSOR GANS MISCHARACTERIZES THE OPERATION OF GOOGLE AD MANAGER'S DYNAMIC REVENUE SHARING FEATURE (DRS)

93. Like Bernanke,[46] DRS went through a number of versions that were designed to increase the number of publisher impressions that cleared while achieving consistent margin (revenue share) targets. My source code analysis of DRS v.1 and v.2 demonstrates that Professor Gans is incorrect in his claim that DRS increased Google's sell-side revenue share for some publishers.[47] See Technical Appendix §II and §III, distributed separately, for my full analysis. My own source code analysis shows that neither DRS v.1 nor DRS v.2 increased Google's sell-side revenue share for any publisher above the pre-DRS status quo.

94. Specifically, DRS v.1 always produces a revenue share for each publisher that is at least as large as the non-DRS revenue share for the publisher. DRS v.2 also produces an aggregate revenue share for each publisher that is at least as large as the non-DRS revenue share for the publisher. With each of DRS v.1 and DRS v.2, each publisher therefore receives an aggregate revenue share that is at least as large as the publisher would receive without DRS v.1 or DRS v.2.

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46 However, unlike Bernanke, which is a *buy*-side program, DRS is a *sell*-side program.

47 Gans Report ¶ 824 ("The month DRS v1 is [sic] launched, hundreds of publishers were charged more than [redacted]. The number of publishers charged more than [redacted] increases over time after the DRS v1 launch."); Gans Report ¶ 842 ("More importantly, DRS v1 and v2 increased the average monthly take rate charged to some publishers… Some web properties incurred a substantial average monthly rate increase of much more than [redacted]); Gans Report ¶ 843 ("DRS v1 even appeared to have raised – not lowered – the take rate charged by AdX for several publisher web properties."). While Professor Gans primarily uses the naming convention of "take rate" to refer to Google's share of the revenue received from the buyer in a particular transaction, for clarity and consistency I have adopted the term "revenue share" to refer to the publisher's and Google's respective shares of the revenue received. *See also* Gans Report ¶ 183 ("[P]roviders of ad exchanges receive a percentage of publishers' payout ("take-rate" or "revenue share.")).

A. Overview of Dynamic Revenue Sharing v.1 (DRS v.1)

95. To understand the operation of DRS v.1, it is helpful to understand a few points about the operation of AdX's auction before DRS v.1 was introduced, as described in various technical documents and code that I reviewed as part of my analysis.

96. *First,* prior to the introduction of DRS, Google applied fixed revenue share ("revshare") ratios to AdX auctions; publishers received a determined percentage of AdX auction revenue from their properties, which could vary by transaction type[48] and was subject to negotiation[49] (and was thus stored and retrieved by Google's systems on a per-publisher basis).

97. My understanding is that the most common value for open auction transactions was 80%, such that most publishers would receive 80% of the winning bid's price (for "Open Auction" or "OA" transactions), and Google's revenue share for such transactions would be 20%.[50] For simplicity, I follow Google's convention of using an 80/20 split as the illustrative example in my discussion below,[51] but nothing in my analysis turns on the particular percentage negotiated by a given publisher.[52]

98. *Second,* publishers were able to specify floor (or reserve) prices for their auctions, expressed as the minimum amount they would need to receive from the auction for it to clear. Thus, for an AdX bid to win an auction before the introduction of DRS, not only did the bid's price need to

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48 GOOGEDTX-SC-00046 ([redacted]) (1/1/2015 snapshot), at lines 86-102. The code in [redacted] of the auctioned impression: [redacted] Technical Appendix §II.B for discussion of how this function is used in DRS v.1.

49 *See* GOOG-DOJ-06867901, at -901 [redacted].

50 See GOOGEDTX-SC-00007 [redacted] (1/1/2015 snapshot), at lines 44-45. [redacted]. The 80% number is also used as an example in Google's design documents, but nothing in my analysis turns on the particular percentage negotiated by a publisher, *see Id.*

51 *See, e.g.*, GOOG-DOJ-06867901 at -901 (explaining that "[redacted]

52 *See* GOOG-DOJ-06867901 at -901 [redacted]

exceed the relevant reserve price (and other competing bids), but the bid minus Google's (for purposes of illustration) 20% revenue share also needed to exceed the reserve price so that the publisher's post-revshare revenue met the reserve price. Otherwise, the auction would not clear because the publisher's reserve price was not met.[53]

99. DRS follows from Google's observation of the existence of a potential "dynamic region," i.e., a range of bids that would be below the floor with Google's revenue share for the publisher applied, but above the floor without Google's revenue share applied.[54] The basic idea of DRS v.1 is to dynamically reduce Google's revenue share in such situations to allow more auctions to clear.[55] One of the key design points of DRS v.1 is that it only ever reduces Google's revenue share below 20% – i.e., DRS v.1 never increases Google's revenue share above 20% on any transaction.[56] This logically aligns with the goal of DRS v.1 to allow more auctions to clear, since if Google's revenue share is lowered below 20%, then advertisers' bids will be effectively higher (assuming reserve prices are constant).

100. Professor Hochstetler correctly describes the initial 2015 version of DRS v.1 as "only lower[ing] AdX's revenue share, never raising it."[57] Yet, Professor Gans claims that "DRS v1 and v2 increased the average monthly take rate charged to some publishers."[58] Professor Gans also claims that starting "[t]he month DRS v.1 is launched, hundreds of publishers were charged more than 20%" and that "DRS v. 1 even appeared to have raised - not lowered - the take rate charged

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53 GOOG-DOJ-03620221 at -222 [redacted].").

54 GOOG-DOJ-13221355 at -356 ([redacted]

55 GOOG-DOJ-15130321 at -321 [redacted]").

56 GOOG-DOJ-03620221 at -222 ("[redacted]

57 See Hochstetler Report, ¶ 262. ("The first version of DRS was launched in 2015 and only lowered AdX's revenue share, never raising it as in future versions of DRS.").

58 Gans Report, ¶ 842 ("More importantly, DRS v1 and v2 increased the average monthly take rate charged to some publishers.").

by AdX for several publisher web properties…”[59] The source code I analyzed is not consistent with Professor Gans' claims.

101. I performed a source code analysis of the 1/1/2015 snapshot,[60] which includes the implementation of DRS v.1.

102. My analysis shows two aspects of DRS v.1 that are relevant to Professor Gans' claims regarding DRS increasing/raising Google's sell-side revenue share. First, the AdX auction implementation, which includes DRS v.1, always ensures that each publisher's revenue share is at least as large as (or larger than) the publisher's revenue share without DRS,[61] whether DRS v.1 is enabled or not (this is also true for DRS v.2, see Section III.A). Second, DRS v.1 used a [redacted].[62]

103. Specifically, my source code analysis shows that when DRS v.1 was active, the DRS v.1 code ensures that, for each impression, the publisher's revenue share from the auction of that impression would always be at least as large as (or larger than) the publisher's revenue share without DRS. So long as that property is true for each auction, it follows that DRS v.1 could therefore never increase Google's aggregate revenue share for a publisher above what that

59 Gans Report, ¶ 824 (“The month DRS v1 is launched, hundreds of publishers were charged more than 20%.”); Gans Report, ¶ 843 (“DRS v1 even appeared to have raised – not lowered – the take rate charged by AdX for several publisher web properties, even though Google's internal document and contractual language indicate that revenue share is averaged over a monthly billing period.”).

60 I selected the 1/1/2015 snapshot because it is the most appropriately dated version of Google's produced source code to see how DRS v.1 operated with minimal, if any, modifications for DRS v.2. Because I understand that DRS v.1 launched to general availability on or about August 20, 2015 (Defendant Google LLC's First Amended Responses and Objections to Plaintiffs' Third Set of Interrogatories, The State of Texas, et al. v. Google LLC, 4:20-cv-957-SDJ, at 12 (“Dynamic Revenue Share launched on or about August 20, 2015.”)), I searched the changelog database and confirmed that there were no changes to the files described in this section between January 1 and August 20, 2015 that would materially alter the conclusions of my analysis. The later 1/15/2017 snapshot would include DRS v.2, while the earlier 1/2013 snapshot would be prior to DRS v.1.

61 GOOG-DOJ-06867901, at -901. ([redacted]

62 See GOOGEDTX-SC-00006 ([redacted]

publisher's revenue share would have been in the absence of DRS v.1, no matter how many transactions DRS v.1 did or did not apply to.

B. DRS v.1's [redacted]

104. As noted above, DRS v.1 uses what Google refers to as [redacted]. Because the publisher earns at least as high and potentially a higher revenue share when DRS is applied than when it is not, [redacted].

105. The [redacted] consisting of two steps. The first is an [redacted].[64] The second step [redacted] See Technical Appendix §II.A. [redacted]

106. Note that the [redacted] DRS; [redacted]. See Technical Appendix §II.A for details of the [redacted] in DRS v.1.

C. DRS v.1's Implementation In The AdX Auction

107. The second part of the DRS v.1 implementation is part of the [redacted]. For each auction, AdX determines, using the [redacted], whether to apply DRS. Although the details are described in the Technical Appendix, the basic idea is that a [redacted]

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63 [redacted].

64 See generally GOOGEDTX-SC-00005 ([redacted]

[redacted]).[65]

108. My analysis of the AdX auction code (including DRS v.1) also identifies the data structure and field within this data structure where the source code stores the revenue share that the publisher receives from the auction of the impression. [redacted] See Technical Appendix §II.B for the complete discussion.

109. [redacted]

110. The publisher therefore receives a share of the revenue from each auction that is at least as large as the publisher's non-DRS revenue share (which, as noted above, I understand to typically be 80%). The publisher's revenue share over all auctions (regardless of the sequence and number of DRS-eligible and DRS-throttled auctions) is therefore at least as large as the publisher's non-DRS revenue share.

D. Overview of Dynamic Revenue Sharing v.2 (DRS v.2)

111. DRS v.2 expands on DRS v.1 by introducing a recoupment system for both publishers (sellers) and advertisers (buyers) using what are internally referred to as [redacted].[66,67] The design of DRS v.2 retains the advantages of DRS v.1 and is designed to maintain a targeted per-publisher aggregate AdX revenue share, but, by

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65 ([redacted]

66 See GOOG-DOJ-13207875 at -879. [redacted]

67 See generally GOOGEDTX-SC-00033 ([redacted] (1/15/2017 snapshot). ("[redacted]")

allowing Google's revenue share on some transactions to exceed its non-DRS revenue share for purposes of recoupment, the algorithm can take a smaller revenue share on other transactions—thereby clearing more overall impressions for publishers—while still maintaining the targeted margin for transactions overall. As shown below and in my source code analysis, the recoupment mechanism ensures that each publisher continues to receive at least its non-DRS revenue share in the aggregate while maintaining the DRS goal of allowing more transactions to clear (so that advertisers' ads are shown and publishers are paid).[68]

112. I performed a source code analysis of the 1/15/2017 snapshot which includes the implementation of DRS v.2. See Technical Appendix §III.

113. My analysis of the DRS v.2 source code identified a [redacted].

114. When DRS v.2 is enabled, the code that updates the [redacted] implements two cases:

a. **The winning bid is in the dynamic region:** [redacted].[69] [redacted].

[68] GOOG-DOJ-06867901 at -901. [redacted]).

[69] See GOOGEDTX-SC-00039 ([redacted]) (1/15/2017 snapshot), at lines 232-235.

b. **The winning bid is above the dynamic region:** [redacted]. [redacted].[73]

115. [redacted], the fraction of the total revenue over all impressions that the publisher receives is always at least as large as the publisher's non-DRS fraction of the total revenue over all impressions.[74]

70 See GOOGEDTX-SC-00039 ([redacted]) (1/15/2017 snapshot), at lines 295-314.

71 See GOOGEDTX-SC-00039 ([redacted]) (1/15/2017 snapshot), at lines 295 and 313-314.

72 [redacted]

73 [redacted]

74 [redacted]

116. My analysis of the DRS v.2 source code identified the data structure and field within this data structure that stores the fraction of the revenue share that the publisher receives from the auction of the impression. [redacted].

117. [redacted]ve. My analysis confirms that the value of [redacted] that the software computes for each auction accurately implements the division of revenue between Google and the publisher discussed above.

118. [redacted] The code also ensures that [redacted] is at least as large as the publisher's non-DRS revenue share,[76] [redacted]

119. [redacted]

E. DRS v.2's [redacted] Never Made Publishers Worse Off

[redacted]

[75] See GOOGEDTX-SC-00039 [redacted] (1/15/2017 snapshot), at lines 232-238.

[76] See GOOGEDTX-SC-00039 ([redacted] (1/15/2017 snapshot), at lines 217-220.

[77] See GOOGEDTX-SC-00039 ([redacted]) (1/15/2017 snapshot), at lines 85-90.

[78] See GOOGEDTX-SC-00039 [redacted] (1/15/2017 snapshot), at lines 307-310.

[79] See GOOGEDTX-SC-00035 [redacted]) (1/15/2017 snapshot), at lines 485-487 for the invocation of [redacted]), and GOOGEDTX-SC-00039 ([redacted]) (1/15/2017 snapshot), at lines 166-319 for its definition.

[80] See GOOGEDTX-SC-00035 ([redacted]) (1/15/2017 snapshot), at lines 490-498 to see the conclusion of the [redacted]."

[redacted]

121. My analysis of DRS v.2's [redacted] is fully spelled out in Technical Appendix §III.B, but I summarize the key points below.

122. [redacted] For example, if the non-DRS revenue share was 0.80, the transaction clearing price was \$1.00, the floor price was \$0.90, and DRS v.2 increased the publisher's revenue share to 90% to allow the transaction to clear, Google lost (\$1.00 × (1 - 0.8)) - (\$1.00 × (1 - 0.9)) = \$0.10 as a result of DRS v.2.

123. [redacted].[82,83,84]

124. [redacted]

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81 [redacted]

82 See Technical Appendix §III.B.i, ¶¶ 93-94. ([redacted]").

83 See Technical Appendix Figure TA.19, at lines 199-204, 228, and 236. See also Technical Appendix Figure TA.20, at lines 199-204, 270, and 315. [redacted].

84 [redacted], but that is not directly relevant to Professor Gans' claims. For more details, see Technical Appendix §III.B ("[redacted]

[redacted] A publisher with a [redacted] has therefore received a higher revenue share with DRS than it would have received without it.

125. When AdX later receives bids for another transaction from the same publisher that are [redacted].[86] In other words:

a. [redacted]

b. [redacted]

126. [redacted].

127. [redacted]

128. [redacted] publisher's gains from DRS v.2 (relative to its non-DRS revenue share) will be greater than or equal to its losses (from recoupment), so it is impossible for the publisher to have an overall revenue share less than its non-DRS revenue share.

85 [redacted]

86 See Technical Appendix §III.B.ii, ¶ 114. [redacted])

129. As a result, like DRS v.1, DRS v.2 as implemented in the source code I reviewed was not capable of increasing Google's revenue share above its non-DRS revenue share as claimed by Professor Gans.

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Martin Rinard, Ph. D

Date: July 30, 2024

Appendix A:
Curriculum Vitae

CURRICULUM VITAE

Martin C. Rinard

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Computer Science and Artificial Intelligence Laboratory
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RESEARCH INTERESTS

Computer Systems, Computer Security, Programming Languages, Machine Learning, Artificial Intelligence, Software Engineering, Program Analysis, Program Verification, Compilers, Real-Time Systems, Embedded Systems, Distributed Systems, Parallel Systems, Game Theory.

EDUCATION

Stanford University. Ph.D. in Computer Science, Summer 1994.
Thesis: The Design, Implementation and Evaluation of Jade: A Portable, Implicitly Parallel Programming Language.
Advisor : Professor Monica S. Lam.

Brown University. Sc.B. in Computer Science, Magna Cum Laude and with Honors, June 1984.
Honors Thesis: The Internal Structure of an Ideographic Programming Environment.
Advisor: Professor Thomas W. Doeppner, Jr.

ACADEMIC EXPERIENCE

2006 – present	**Professor,** Massachusetts Institute of Technology, Cambridge, Massachusetts.
2000 – 2006	**Associate Professor,** Massachusetts Institute of Technology, Cambridge, Massachusetts.
1997 – 2000	**Assistant Professor,** Massachusetts Institute of Technology, Cambridge, Massachusetts.
1994 – 1997	**Assistant Professor,** University of California at Santa Barbara, Santa Barbara, California.
1986 – 1994	**Research Assistant,** Stanford University, Stanford, California.
1989	**Teaching Fellow**, Stanford University, Stanford, California.
1982 – 1983	**Research Assistant**, Brown University, Providence, Rhode Island.

PROFESSIONAL EXPERIENCE

1985 - 1986	**Software Engineer**, Polygen Corporation, Waltham, Massachusetts. Member of a team developing a computer-aided molecular design system. Designed and implemented a novel algorithm for embedding complex merged and bridged ring systems into 3-space, and an algorithm for automatically determining atom types for molecular mechanics programs given a molecule's chemical structure.
1984 - 1985	**Software Engineer**, Ikan Systems, Providence, Rhode Island. Member of a team developing an electronic publishing system. Responsible for helping to design the user interface, designing software tools to implement the user interface, and implementing the user interface. Designed a hierarchical graphics package and a package to generate and automatically maintain graphical representations of data objects. Designed and implemented a special-purpose, explicitly parallel language for processing sequences of user actions.

HONORS AND AWARDS

Distinguished Paper Award, The ACM Joint European Software Engineering Conference and Symposium on the Foundations of Software Engineering, August 2021

Best Paper Award, OOPSLA 2014

Best Paper Award, OOPSLA 2013

The Most Notable Paper Award / Onward! 2013

One of 25 Most Significant Papers from First 20 Years of IEEE International Symposium on Field-Programmable Custom Computing Machines

Best Paper Award, 33rd ACM SIGPLAN Conference on Programming Language Design and Implementation (PLDI 2012), June 2012

Best Paper Award, 32nd ACM SIGPLAN Conference on Programming Language Design and Implementation (PLDI 2011), June 2011

ACM Fellow, December 2009

Distinguished Paper Award, The 27th International Conference on Software Engineering, May 2005

Distinguished Paper Award, The 12th ACM Symposium on the Foundations of Software Engineering, November 2004

Most Influential Paper in 20 Years Award, Area: Concurrent Constraint Programming, The Association for Logic Programming, 2004

Solomon Buchsbaum AT&T Research Fund Award, 1999

Everett Moore Baker Memorial Award for Excellence in Undergraduate Teaching at MIT, Honorable Mention, 1998

National Science Foundation Faculty Early Career Development Award, 1997

University of California, Santa Barbara Outstanding Faculty Member in Computer Science, 1996

Alfred P. Sloan Research Fellowship, 1995

Brown University Undergraduate Research Fellowship, 1983

PUBLICATIONS

Farid Arthaud, Edan Orzech, Martin Rinard. Edge-Dominance Games on Graphs. Cornell University: *Computer Science and Game Theory.* July 2024.

McCoy R. Becker, Alexander K. Lew, Xiaoyan Wang, Matin Ghavami, Mathieu Huot, Martin C. Rinard, Vikash K. Mansinghka, Probabilistic Programming with Programmable Variational Inference, *Proceedings of the ACM on Programmic Languages, Volume 8*. June 20, 2024.

Mathieu Huot, Matin Ghavami, Alexander K. Lew, Ulrich Schaechtle, Cameron E. Freer, Zane Shelby, Martin C. Rinard, Feras A. Saad, Vikash K. Mansinghka. GenSQL: A Probabilistic Programming System for Querying Generative Models of Database Tables, Cornell University: *Programming Languages*. June 21, 2024.

Kai Jia, Martin Rinard. Limited-Perception Games. Cornell University: Computer Science and Game Theory. May 27, 2024.

Martin Rinard. Software Engineering Research in a World with Generative Artificial Intelligence. *ICSE '24: Proceedings of the IEEE/ACM 46th International Conference on Software Engineering.* May 20, 2024.

Toni Mattis, Eva Krebs, Martin C. Rinard, Robert Hirschfeld, Examples out of Thin Air: AI-Generated Dynamic Context to Assist Program Comprehension by Example. *PX/24 Programming Conference*. March 1, 2024.

Toni Mattis, Lukas Bohme, Eva Krebs, Martin C. Rinard, Robert Hirschfeld. Faster Feedback with AI? A Test Prioritization Study. *Programming '24: Companion Proceedings of the 8th International Conference on the Art, Science, and Engineering of Programming*. July 9, 2024.

Eva Krebs, Toni Mattis, Marius Dorbandt, Oliver Schulz, Martin C. Rinard, Robert Hirschfeld. Implementing Babylonian/G by Putting Examples into Game Contexts. *Companion Proceedings of the 8th International Conference on the Art, Science, and Engineering of Programming, Lund, Sweden, March 2024.*

Kai Jia, Bowen Gu, Pasapol Saowakon, Steven Kundrot, Matvey B. Palchuk, Jeff Warnick, Irving D. Kaplan, Martin Rinard, Limor Appelbaum, LIRIC predicts Hepatocellular Carcinoma Risk in the Diverse US Population Using Routine Clinical Data, *medRXiv: The Preprint Server for Health Sciences,* May 29, 2024.

Kai Jia, Steven Kundrot, Matvey Palchuk, Jeff Warnick, Kathryn Haapala, Irving Kaplan, Martin C. Rinard, Limor Applebaum. A pancreatic cancer risk prediction model (Prism) developed and validated on large-scale US clinical data. eBioMedicine Volume 98, 104888, November 2023.

Alexander Lew, Matin Ghavamizadeh, Martin C. Rinard, Vikash Mansinghka. Probabilistic Programming with Stochastic Probabilities. Proceedings of the ACM on Programming Languages, Volume 7, PLDI, Orlando, Florida, June 2023. Farid Arthaud, Martin C. Rinard. Depth-Bounded Epistemic Logic. Proceedings of Nineteenth Conference on Theoretical Aspects of Rationality, Oxford, United Kingdom, June 2023.

Charles Jin, Melinda Sun, Martin C. Rinard. Incompatibility Clustering as a Defense Against Backdoor Poisoning Attacks. The Eleventh International Conference on Learning Representations (ICLR 2023), Kigali, Rwanda, May 2023.

Charles Jin, Zhang-Wei Hong, Martin C. Rinard. Toward Capability-Aware Cooperation for Decentralized Planning. Proceedings of the IROS Workshop on Decision Making in Multi-Agent Systems, Kyoto Japan, October 2022.

Yichen Yang, Kai Jia, Martin C. Rinard. On the Impact of Player Capability on Congestion Games. Proceedings of the 15th International Symposium on Algorithmic Game Theory (SAGT 2022), Colchester, United Kingdom, September 2022.

Jiasi Shen, Martin C. Rinard, Nikos Vasilakis. Automated Synthesis of Parallel Unix Commands and Pipelines with Kumquat. *Proceedings of the 27th ACM SIGPLAN Annual Symposium on Principles and Practice of Paralle Programming (PPoPP 2022) (Poster)*, Republic of Korea, April 2022.

Limor Appelbaum, Irving Kaplan, Matvey Palchuk, Steven Kundrot, Jessamine Winer-Jones, Martin C. Rinard. Development and Experience with Cancer Risk Prediction Models Using Federated Databases and Electronic Health Records. *Exon Publications,* February 2022.

Charles Jin, Martin C. Rinard. Towards Context-Agnostic Learning Using Synthetic Data. In *Proceedings of the Thirty-fifth Conference on Neural Information Processing Systems (NeurIPS 2021),* Virtual, December 2021.

Yichen Yang, Jeevana Priya Inala, Osbert Bastani, Yewen Pu, Armando Solar-Lezama, Martin C. Rinard. Program Synthesis Guided Reinforcement Learning for Partially Observed Environments (Spotlight Presentation). In *Proceedings of the Thirty-fifth Conference on Neural Information Processing Systems (NeurIPS 2021),* Virtual, December 2021.

Nikos Vasilakis, Achilles Benetopoulos, Shivam Handa, Alizee Schoen, Jiasi Shen, Martin C. Rinard. Supply-Chain Vulnerability Elimination via Active Learning and Regeneration. In *Proceedings of the ACM Conference on Computer and Communications Security (ACMCCS 2021),* Virtual, South Korea, November 2021.

Kai Jia, Martin C. Rinard. Exploiting Verified Neural Networks via Floating Point Numerical Error. In *Proceedings of the 28th Static Analysis Symposium (SAS 2021),* Virtual, Chicago, Illinois, October 2021.

Kai Jia, Martin C. Rinard. Verifying Low-Dimensional Input Neural Networks via Input Quantization. In *Proceedings of the 28th Static Analysis Symposium (SAS 2021),* Virtual, Chicago, Illinois, October 2021.

Shivam Handa, Konstantinos Kallas, Nikos Vasilakis, Martin C. Rinard. An Order-Aware Dataflow Model for Parallel Unix Pipelines. In *Proceedings of the ACM on Programming Languages (ICFP),* Volume 5 (August 2021).

Nikos Vasilakis, Grigoris Ntousakis, Viet Heller, Martin C. Rinard. Efficient Module-Level Dynamic Analysis for Dynamic Languages with Module Recontextualization. In *Proceedings of the ACM Joint European Software Engineering Conference & Symposium on the Foundations of Software Engineering (ESEC/FSE 2021),* Virtual, August 2021.

Feras Saad, Martin C. Rinard, Vikash Mansinghka. SPPL: Probabilistic Programming with Fast Exact Symbolic Inference. In Proceedings of the 42nd ACM SIGPLAN International Conference on Programming Language Design and Implementation (PLDI 2021), Virtual, Canada, June 2021.

Fatjon Zogaj, Jose Cambronero, Martin C. Rinard, Jurgen Cito. Doing More with Less: Characterizing Dataset Downsampling for AutoML. In Proceedings of the VLDB Endowment, Volume 14, Number 11 (July 2021).

Jiasi Shen, Martin C. Rinard. Active Learning for Inference and Regeneration of Applications that Access Databases. In ACM Transactions on Programming Languages and Systems, Volume 42, Number 4 (February 2021).

Limor Appelbaum, Jose P. Cambronero, Jennifer P. Stevens, Steven Horng, Karla Pollick, George Silva, Sebastien Haneuse, Gail Piatkowski, Nordine Benhaga, Stacey Duey, Mary A. Stevenson, Harvey Mamon, Irving D. Kaplan, Martin C. Rinard. Development and validation of a pancreatic cancer risk model for the general population using electronic health records: An observational study. In European Journal of Cancer, Volume 143, pp. 19-30, 2021.

Jeevana Priya Inala, Yichen Yang, James Paulos, Yewen Pu, Osbert Bastani, Vijay Kumar, Martin C. Rinard, Armando Solar-Lezama. Neurosymbolic Transformers for Multi-Agent Communication, In Advances in Neural Information Processing Systems 33: Annual Conference on Neural Information Processing Systems, NeurIPS 2020, Virtual, December 2020.

Kai Jia, Martin C. Rinard. Efficient Exact Verification of Binarized Neural Networks, In Advances in Neural Information Processing Systems 33: Annual Conference on Neural Information Processing Systems, NeurIPS 2020, Virtual, December 2020.

Shivam Handa, Martin C. Rinard. Inductive Program Synthesis Over Noisy Data, In *ESEC/FSE ’20: 28th ACM Joint European Software Engineering Conference and Symposium on the Foundations of Software Engineering,* Virtual, USA, November 2020.

Jose Cambronero, Jurgen Cito, Martin C. Rinard. AMS: Generating AutoML Search Spaces from Weak Specifications, In *ESEC/FSE ’20: 28th ACM Joint European Software Engineering Conference and Symposium on the Foundations of Software Engineering,* Virtual, USA, November 2020.

Feras Saad, Cameron Freer, Martin C. Rinard, Vikash Mansinghka. The Fast Loaded Dice Roller: A Near-Optimal Exact Sampler for Discrete Probability Distributions, In *Proceedings of 23rd International Conference on Artificial Intelligence and Statistics (AISTATS 2020),* Online, August 2020.

Jeff Perkins, Jordan Eikenberry, Alessandro Coglio, Martin C. Rinard. Comprehensive Java Metadata Tracking for Attack Detection and Repair, In *50th Annual IEEE/IFIP International Conference on Dependable Systems and Networks (DSN 2020),* Valencia, Spain, June 2020.

Jurgen Cito, Jiasi Shen, Martin C. Rinard. An Empirical Study on the Impact of Deimplicitization on Comprehension in Programs Using Application Frameworks, In *MSR ’20: 17th International Conference on Mining Software Repositories,* Seoul, Republic of Korea, June 2020.

Sara Achour, Martin C. Rinard. Noise-Aware Dynamical System Compilation for Analog Devices with Legno, In *Proceedings of the Twenty-Fifth International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS 2020),* Lausanne, Switzerland March 2020.

Phillip Stanley-Marbell, Martin C. Rinard. Warp: A Hardware Platform for Efficient Multimodal Sensing with Adaptive Approximation, In *IEEE Micro 48(1),* Jan.-Feb. 2020.

Malavika Samak, Deokhwan Kim, Martin C. Rinard. Synthesizing Replacement Classes, In *Proceedings of the ACM on Programming Languages 4 (POPL 2020),* New Orleans, Louisiana January 2020.

Feras Saad, Cameron Freer, Martin C. Rinard, Vikash Mansinghka. Optimal Approximate Sampling from Discrete Probability Distributions, In *Proceedings of the ACM on Programming Languages 4 (POPL 2020),* New Orleans, Louisiana January 2020.

Jose Cambronero, Martin C. Rinard. AL: Autogenerating Supervised Learning Programs, In *Proceedings of the ACM on Programming Languages 3 (OOPSLA 2019),* Athens, Greece October 2019.

Jose Cambronero, Thurston Dang, Nikos Vasilakis, Jiasi Shen, Jerry Wu, Martin C. Rinard. Active Learning for Software Engineering, In *Proceedings of the 2019 ACM SIGPLAN International Symposium on New Ideas, New Paradigms, and Reflections on Programming and Software (Onward! ‘19),* Athens, Greece October 2019.

Jose Cambronero, Jiasi Shen, Jurgen Cito, Elena Glassman, Martin C. Rinard. Characterizing Developer Use of Automatically Generated Patches. In Proceedings of the 2019 IEEE Symposium on Visual Languages and Human-Centric Computing (VL/HCC), Memphis, Tennessee October 2019.

Jiasi Shen, Martin C. Rinard. Using Active Learning to Synthesize Models of Applications that Access Databases, In Proceedings of the 40th ACM SIGPLAN Conference on Programming Language Design and Implementation (PLDI 2019), Phoenix, Arizona June 2019.

Jurgen Cito, Philipp Leitner, Martin C. Rinard, Harald Gall. Interactive Production Performance Feedback in the IDE. In Proceedings of the 41st International Conference on Software Engineering (ICSE 2019), Montreal, Canada May 2009.

Martin C. Rinard. Technical Perspective: Borrowing Big Code to Automate Programming Activities, In Communications of the ACM 62(3), February 2019.

Feras Saad, Marco Cusumano-Towner, Martin C. Rinard, Vikash Mansinghka. Bayesian Synthesis of Probabilistic Programs for Automatic Data Modeling, In Proceedings of ACM on Programming Languages 3 (POPL 2019), Cascais, Portugal January 2019.

Martin C. Rinard, Jiasi Shen, Varun Mangalick. Active Learning for Inference and Regeneration of Computer Programs that Store and Retrieve Data, In Proceedings of the 2018 ACM SIGPLAN International Symposium on New Ideas, New Paradigms, and Reflections on Programming and Software (Onward! 2018), Boston, Massachusetts November 2018.

Vladimir Kiriansky, Haoran Xu, Martin C. Rinard, Saman Amarasinghe. Cimple: Instruction and Memory Level Parallelism: A DSL for Uncovering ILP and MLP, In *Proceedings of the 27th International Conference on Parallel Architectures and Compilation Techniques (PACT 18),* Limassol, Cyprus November 2018.

Phillip Stanley-Marbell, Martin C. Rinard. Perceived-Color Approximation Transforms for Programs that Draw, In *IEEE Micro 38(4),* Jul./Aug. 2018.

Justin Gottschlich, Armando Solar-Lezama, Nesime Tatbul, Michael Carbin, Martin C. Rinard, Regina Barzilay, Saman P. Amarasinghe, Joshua Tenenbaum, Tim Mattson. The Three Pillars of Machine Programming, In *Proceedings of the 2nd ACM SIGPLAN International Workshop on Machine Learning and Programming Languages (MAPL@PLDI 2018),* Philadelphia, Pennsylvania June 2018.

Vikash Mansingha, Ulrich Schaechtle, Shivam Handa, Alexey Radul, Yutian Chen, Martin C. Rinard. Probabilistic Programming with Programmable Inference, In *Proceedings of the 39th ACM SIGPLAN Conference on Programming Language Design and Implementation (PLDI 2018),* Philadelphia, Pennsylvania, June 2018.

Sara Achour, Martin C. Rinard. Time Dilation and Contraction for Programmable Analog Devices with Jaunt, In *Proceedings of Twenty-Third International Conference on Architectural Support for Programming Languages and Operating Systems,* Williamsburg, Virginia, March 2018.

Phillip Stanley-Marbell, Martin C. Rinard. Error-Efficient Computing Systems, *Foundations and Trends in Electronic Design Automation,* 11(4), December 2017.

Jiasi Shen, Martin C. Rinard. Robust Programs with Filtered Iterators, In *Proceedings of 10th ACM SIGPLAN International Conference on Software Language Engineering,* Vancouver, Canada, October 2017.

Stelios Sidiroglou-Douskos, Eric Lahtinen, Anthony Eden, Fan Long, Martin C. Rinard. CodeCarbonCopy, In *Proceedings of 2017 11th Joint Meeting of the European Software Engineering Conference and the ACM SIGSOFT Symposium on the Foundations of Software Engineering,* Paderborn, Germany, September 2017.

Fan Long, Peter Amidon, Martin C. Rinard. Automatic Inference of Code Transforms for Patch Generation, In *Proceedings of 2017 11th Joint Meeting of the European Software Engineering Conference and the ACM SIGSOFT Symposium on the Foundations of Software Engineering,* Paderborn, Germany, September 2017.

Jurgen Cito, Julia Rubin, Phillip Stanley-Marbell, Martin C. Rinard. Battery-Aware Transformations in Mobile Applications, In *Proceedings of the 31st IEEE/ACM International Conference on Automated Software Engineering (ASE 2016),* Singapore, September 2016.

Phillip Stanley-Marbell, Martin C. Rinard. Encoder Logic for Reducing Serial I/O Power in Sensors and Sensor Hubs. In Proceedings of Hot Chips Symposium 2016, Cupertino, California, August 2016.

Michael Carbin, Sasa Misailovic, Martin C. Rinard. Verifying Quantitative Reliability for Programs that Execute on Unreliable Hardware, In Communications of the ACM 59(8), August 2016.

Fereshte Khani, Martin C. Rinard, Percy Liang. AutoRand: Unanimous Prediction for 100% Precision with Application to Learning Semantic Mappings, In Proceedings of Association for Computational Linguistics 2016 Conference (ACL 2016), Berlin, Germany, August 2016.

Jeff Perkins, Jordan Eikenberry, Alessandro Coglio, Daniel Willenson, Stelios Sidiroglou-Douskos, Martin C. Rinard. AutoRand: Automatic Keyword Randomization to Prevent Injection Attacks, In Proceedings of the 13th Conference on Detection of Intrusions and Malware & Vulnerability Assessment (DIMVA 2016), Donostia-San Sebastian, Spain, June 2016.

Sara Achour, Rahul Sarpeshkar, Martin C. Rinard. Configuration Synthesis for Programmable Analog Devices with Arco, In Proceedings of the 37th ACM SIGPLAN Conference on Programming Language Design and Implementation (PLDI 2016), Santa Barbara, California, June 2016.

Phillip Stanley-Marbell, Martin C. Rinard. Reducing Serial I/O Power in Error-Tolerant Applications by Efficient Lossy Encoding, In Proceedings of the 53rd Annual Design Automation Conference (DAC 2016), Austin, Texas, June 2016.

Fan Long, Martin C. Rinard. An Analysis of the Search Spaces for Generate and Validate Patch Generation Systems, In *Proceedings of the ACM/IEEE 38th International Conference on Software Engineering),* Austin, Texas, May 2016.

Julia Rubin, Martin C. Rinard. The Challenges of Staying Together While Moving Fast, In *Proceedings of the ACM/IEEE 38th International Conference on Software Engineering),* Austin, Texas, May 2016.

Phillip Stanley-Marbell, Virginia Estellers, Martin C. Rinard. Crayon: Saving Power through Shape and Color Approximation on Next-Generation Displays, In *Proceedings of EuroSys 2016,* London, UK, April 2016.

Fan Long, Martin C. Rinard. Automatic Patch Generation By Learning Correct Code, In *Proceedings of the 43rd ACM SIGPLAN-SIGACT Symposium on Principles of Programming Languages (POPL 2016),* St. Petersburg, Florida, January 2016.

Phillip Stanley-Marbell, Martin C. Rinard. Efficiency Limits for Value-Deviation-Bounded Approximate Communication, In *IEEE Embedded Systems Letters* 7(4) Dec. 2015.

Julia Rubin, Michael I. Gordon, Nguyen Nguyen, Martin C. Rinard. Covert Communication in Mobile Applications, In *Proceedings of the 30th IEEE/ACM International Conference on Automated Software Engineering,* Lincoln, Nebraska, November 2015.

Sara Achour, Martin C. Rinard. Approximate Computation With Outlier Detection in Topaz, In *Proceedings of the 2015 ACM SIGPLAN International Conference on Object-Oriented Programming, Systems, Languages, and Applications (OOPSLA 2015),* Pittburgh, Pennsylvania, October 2015.

Isaac Evans, Fan Long, Ulziibayar Otgonbaatar, Howard E. Shrobe, Martin C. Rinard, Hamed Okhravi, Stelios Sidiroglou-Douskos. Control Jujutsu: On the Weaknesses of Fine-Grain Control Flow Integrity, In *Proceedings of the 22nd ACM SIGSAC Conference on Computer and Communications Security (CCS 2015),* Denver, Colorado, October 2015.

Peter Amidon, Eli Davis, Stelios Sidiroglou-Douskos, Martin C. Rinard. Program Fracture and Recombination for Efficient Automatic Code Reuse, In *Proceedings of the 2015 IEEE High Performance Extreme Computing Conference (HPEC '15),* Waltham, Massachusetts, September 2015.

Fan Long, Martin C. Rinard. Staged Program Repair with Condition Synthesis, In *Proceedings of the 10th Joint Meeting of the European Software Engineering Conference and the ACM SIGSOFT Symposium on the Foundations of Software Engineering (ESEC/FSE 2015),* Bergamo, Italy, August 2015.

Zichao Qi, Fan Long, Sara Achour, Martin C. Rinard. An Analysis of Patch Plausibility and Correctness for Generate-And-Validate Patch Generation Systems, In *Proceedings of the 2015 International Conference on Software Testing and Analysis (ISSTA 2015),* Baltimore, Maryland, July 2015.

Stelios Sidiroglou-Douskos, Eric Lahtinen, Fan Long, Martin C. Rinard. Automatic Error Elimination by Horizontal Code Transfer Across Multiple Applications, In Proceedings of the 36th ACM SIGPLAN Conference on Programming Language Design and Implementation (PLDI 2015), Portland, Oregon, June 2015.

Phillip Stanley-Marbell, Martin C. Rinard. Lax: Approximating Outside the Processor, In Proceedings of the 2015 Workshop on Approximate Computing Across the Stack (WAX 2015), Portland, Oregon, June 2015.

Sam Fingeret, Julian Gonzalez, Ulziibayar Otgonbaatar, Tiffany Tang, Howard Shrobe, Stelios Sidiroglou-Douskos, Martin C. Rinard, Hamed Okhravi. Missing the Point(er): On the Effectiveness of Code Pointer Integrity, In Proceedings of the 36th IEEE Symposium on Security and Privacy, San Jose, California, May 2015.

Phillip Stanley-Marbell, Martin C. Rinard. Lax: Driver Interfaces for Approximate Sensor Device Access, In Proceedings of the 15th Workshop on Hot Topics in Operating Systems, Kartause Ittingen, Switzerland, May 2015.

Stelios Sidiroglou-Douskos, Eric Lahtinen, Nathan Rittenhouse, Paolo Piselli, Fan Long, Deokhwan Kim, Martin C. Rinard. Principled Sampling for Anomaly Detection, In Proceedings of the Twentieth International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS 2015), Istanbul, Turkey, March 2015.

Brendan Juba, Christopher Musco, Fan Long, Stelios Sidiroglou-Douskos, Martin C. Rinard. Principled Sampling for Anomaly Detection, In *2015 Network and Distributed System Security (NDSS) Symposium,* San Diego, California, February 2015.

Michael I. Gordon, Deokhwan Kim, Jeff Perkins, Limei Gilham, Nguyen Nguyen, Martin C. Rinard. Information Flow Analysis of Android Applications in DroidSafe, In *2015 Network and Distributed System Security (NDSS) Symposium,* San Diego, California, February 2015.

Sasa Misailovic, Michael Carbin, Sara Achour, Zichao Qi, Martin C. Rinard. Chisel: Reliabity- and Accuracy-Aware Optimization of Approximate Computational Kernels, In *Proceedings of 2014 ACM SIGPLAN International Conference on Object-Oriented Programming, Systems, Languages, Applications (OOPSLA 2014),* Portland, Oregon, October 2014.

Fan Long, Stelios Sidiroglou-Douskos, Martin C. Rinard. Automatic Runtime Error Repair and Containment via Recovery Shepherding, In *Proceedings of the 35th ACM Conference on Programming Language Design and Implementation (PLDI 2014),* Edinburgh, United Kingdom, June 2014.

Fan Long, Stelios Sidiroglou-Douskos, Deokhwan Kim, Martin C. Rinard. Sound Input Filter Generation for Integer Overflow Errors, In *Proceedings of the 41st ACM SIPLAN-SIGACT Symposium on Principles of Programming Languages (POPL 2014),* San Diego, California, January 2014.

TEACHING

Winter 1994. CS270A, Advanced Topics in Operating Systems (University of California, Santa Barbara)

Spring 1994. CS260, Advanced Topics in Translation (University of California, Santa Barbara)

Winter 1995. CS270A, Advanced Topics in Operating Systems (University of California, Santa Barbara)

Spring 1995. CS170, Operating Systems (University of California, Santa Barbara)

Fall 1995. CS170, Operating Systems (University of California, Santa Barbara)

Winter 1996. CS270A, Advanced Topics in Operating Systems (University of California, Santa Barbara)

Spring 1996. CS20, Programming Methods (University of California, Santa Barbara)

Fall 1996. CS270A, Advanced Topics in Operating Systems (University of California, Santa Barbara)

Winter 1997. CS290I, Program Analysis (University of California, Santa Barbara)

Spring 1997. CS170, Operating Systems (University of California, Santa Barbara)

Fall 1997. 6.001, Structure and Interpretation of Computer Programs (Recitations) (Massachusetts Institute of Technology)

Spring 1998. 6.033, Computer System Engineering (Recitations) (Massachusetts Institute of Technology)

Fall 1998. 6.892, Advanced Topics in Compilation (Massachusetts Institute of Technology)

Spring 1999. 6.826, Principles of Computer Systems (Massachusetts Institute of Technology)

Fall 1999. 6.035, Computer Language Engineering (Massachusetts Institute of Technology)

Spring 2000. 6.826, Principles of Computer Systems (Massachusetts Institute of Technology)

Fall 2000. 6.035, Computer Language Engineering (Massachusetts Institute of Technology)

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Spring 2002. 6.826, Principles of Computer Systems (Massachusetts Institute of Technology)

Fall 2002. 6.035, Computer Language Engineering (Massachusetts Institute of Technology)

Spring 2003. 6.033, Computer System Engineering (Recitations) (Massachusetts Institute of Technology)

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Spring 2004. 6.826, Principles of Computer Systems (Massachusetts Institute of Technology)

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Spring 2005. 6.033, Computer System Engineering (Recitations) (Massachusetts Institute of Technology)

Fall 2005. 6.035, Computer Language Engineering (Massachusetts Institute of Technology)

Spring 2006. 6.033, Computer System Engineering (Recitations) (Massachusetts Institute of Technology)

Fall 2006. 6.170, Laboratory in Software Engineering (Massachusetts Institute of Technology)

Fall 2007. 6.170, Laboratory in Software Engineering (Massachusetts Institute of Technology)

Fall 2008. 6.197, Performance Engineering of Software Systems

Spring 2009. 6.005, Elements of Software Construction

Fall 2009. 6.883, Special Subject in Computer Science (Foundations of Program Analysis) (Massachusetts Institute of Technology)

Spring 2010. 6.035, Computer Language Engineering (Massachusetts Institute of Technology)

Fall 2010. 6.820, Foundations of Program Analysis (Massachusetts Institute of Technology)

Spring 2011. 6.035, Computer Language Engineering (Massachusetts Institute of Technology)

Fall 2011. 6.UAT, Preparation for Advanced Undergraduate Project (Massachusetts Institute of Technology)

Spring 2012. 6.035, Computer Language Engineering (Massachusetts Institute of Technology)

Fall 2012. 6.UAT, Preparation for Advanced Undergraduate Project (Massachusetts Institute of Technology)

Spring 2013. 6.035, Computer Language Engineering (Massachusetts Institute of Technology)

Fall 2013. 6.UAT, Preparation for Advanced Undergraduate Project (Massachusetts Institute of Technology)

Fall 2014. 6.035, Computer Language Engineering (Massachusetts Institute of Technology)

Spring 2015. 6.033, Computer System Engineering (Recitations) (Massachusetts Institute of Technology)

Spring 2016. 6.035, Computer Language Engineering (Massachusetts Institute of Technology)

Fall 2016. 6.035, Computer Language Engineering (Massachusetts Institute of Technology)

Spring 2017. 6.033, Computer System Engineering (Recitations) (Massachusetts Institute of Technology)

Fall 2017. 6.035, Computer Language Engineering (Massachusetts Institute of Technology)

Spring 2018. 6.UAR, Seminar in Undergraduate Research (Massachusetts Institute of Technology)

Fall 2018. 6.035, Computer Language Engineering (Massachusetts Institute of Technology)

Spring 2019. 6.885, Probabilistic Programming and Artificial Intelligence (Massachusetts Institute of

Technology)

Fall 2019. 6.035, Computer Language Engineering (Massachusetts Institute of Technology)

Spring 2020. 6.885, Probabilistic Programming and Artificial Intelligence (Massachusetts Institute of Technology)

Fall 2020. 6.818, Dynamic Computer Language Engineering (Massachusetts Institute of Technology)

Spring 2021. 6.035, Computer Language Engineering (Massachusetts Institute of Technology)

Fall 2021. 6.UAR, Seminar in Undergraduate Research (Massachusetts Institute of Technology)

Spring 2022. 6.035, Computer Language Engineering (Massachusetts Institute of Technology)

Spring 2022. 6.UAR, Seminar in Undergraduate Research (Massachusetts Institute of Technology)

Fall 2022. 6.190, Introduction to Low-Level Programming in C and Assembly (Massachusetts Institute of Technology)

Spring 2023. 6.1100, Computer Language Engineering (Massachusetts Institute of Technology)

Fall 2023. 6.1120, Dynamic Computer Language Engineering (Massachusetts Institute of Technology)

Spring 2024. 6.1100, Computer Language Engineering (Massachusetts Institute of Technology)

PATENTS

United States Patent 10,539,419. Method and apparatus for reducing sensor power dissipation. Phillip Stanley-Marbell, Martin C. Rinard.

United States Patent 10,135,471. System, method, and apparatus for reducing power dissipation of sensor data on bit-serial communication interfaces. Phillip Stanley-Marbell, Martin C. Rinard.

United States Patent 9,189,254. Translating text to, merging, and optimizing graphical user interface tasks. Nathaniel Kushman, Regina Barzilay, Satchuthananthavale Branavan, Dina Katabi, Martin C. Rinard.

United States Patent 8,839,221. Automatic acquisition and installation of software upgrades for collections of virtual machines. Constantine Sapuntzakis, Martin C. Rinard, Gautam Kachroo.

United States Patent 8,788, 884. Automatic correction of program logic. Jeff Perkins, Stylianos Sidiroglou, Martin C. Rinard, Eric Lahtinen, Paolo Piselli, Basil Krikeles, Timothy Anderson, Greg Sullivan.

United States Patent 7,260,746. Specification based detection and repair of errors in data structures. Brian Demsky, Martin C. Rinard.

LEGAL CONSULTING

United States of America, et al. v. **Google LLC**
United States District Court, Eastern District of Virginia
Case No. 1:23-cv-0108 (The Honorable Leonie M. Brinkema)

Prepared Expert Report, January 2024
Deposition, February 2024

Intellectual Ventures I LLC and Intellectual Ventures II LLC v. **Motorola Mobility LLC**
United States District Court for the District of Delaware
C.A. No. 11-cv-00908 (The Honorable Sue L. Robinson)

Prepared Expert Report, May 2013
Prepared Rebuttal Expert Report, June 2013
Deposition, June 2013
Prepared Two Declarations, August 2013
Testified in Court, March 2015

Apple Computer, Inc. v. **Samsung Electronics Co., LTD., Samsung Electronics America, Inc., and Samsung Telecommunications America, LLC**
United States District Court, Northern District of California, San Jose Division
Case No. 12-cv-00630-LHK (The Honorable Lucy Koh)

Prepared Expert Report, August 2013
Prepared Rebuttal Expert Report, September 2013
Deposition, October 2013
Prepared Declaration, November 2013
Testified in Court, April 2014

MasterObjects, Inc. v. **Google Inc.**
United States District Court, Northern District of California, Oakland Division
Case No. 4:15-CV-01775-PJH

Prepared Expert Declaration, October 2015
Deposition, November 2015

Rovi Corporation and Rovi Guides, Inc. v. **Comcast Corporation, Comcast Cable Communications, LLC, Comcast Cable Communications Management, LLC, Comcast Business Communications, LLC, Comcast Holdings Corporation, Comcast Shared Services, LLC, Technicolor SA, Technicolor USA, Inc., Technicolor Connected Home USA LLC, Pace Ltd, Pace Americas, LLC, Arris International plc, Arris Group Inc., Arris Technology, Inc., Arris Enterprises Inc., Arris Solutions, Inc.**
United States International Trade Commission
Investigation No. 337-TA-1001 (The Honorable David P. Shaw)
Certain Digital Video Receivers and Hardware and Software Components Thereof

Prepared Expert Report, September 2016
Prepared Rebuttal Expert Report, October 2016
Deposition, October 2016
Prepared Direct Witness Statement, November 2016
Prepared Rebuttal Witness Statement, November 2016
Testified at Hearing, December 2016

Waymo, LLC v. Uber Technologies, Inc.; Ottomotto, LLC; Otto Trucking, LLC
United States District Court, Northern District of California, San Francisco Division
Case No. 3:17-cv-00939-WHA (The Honorable William Alsup)

Prepared Expert Report, October 25, 2017

Qualcomm, Incorporated v. Apple, Incorporated
United States District Court, Southern District of California
Case No. 3:17-CV-01375-DMS-MDD (The Honorable Dana Sabraw)

Prepared Expert Report, September, 2018
Prepared Rebuttal Expert Report, October 2018
Deposition, October 2018
Testified in Court, March 2019

Intel Corporation v. **Qualcomm, Incorporated**
Case IPR2018-01334 (PTAB)
U.S. Patent 8,838,949

Prepared Declaration, June 2019
Deposition, August 2019
Prepared Declaration, May 2022
Video Deposition, June 2022

Sonos v. **Alphabet, Inc. and Google, LLC**
Investigation No. 337-TA-1191 (The Honorable Charles Bullock)
Certain Audio Players and Controllers, Components Thereof, and Products Containing Same

Prepared Declaration, June 2020
Video Deposition, June 2020
Prepared Expert Report, October 23, 2020
Prepared Rebuttal Expert Report, November 13, 2020
Video Deposition, November 24, 2020
Prepared Direct Witness Statement, December 18, 2020
Prepared Rebuttal Witness Statement, January 8, 2021
Testified via Video at Hearing, February 24, 2021
Testified via Video at Hearing, February 26, 2021
Prepared Declaration, May 24, 2022

Arendi S.A.R.L. v. **Motorola Mobility LLC f/k/a Motorola Mobility, Inc.**
United States District Court, District of Delaware
(C.A. No. 12-1601-LPS D. Del)

Prepared Rebuttal Expert Report, October 20, 2020
Video Deposition, December 18, 2020

Arendi S.A.R.L. v. **Google LLC**
United States District Court, District of Delaware
(C.A. No. 13-919-LPS D. Del)

Prepared Rebuttal Expert Report, October 20, 2020
Video Deposition, December 17, 2020
Testified in Court, April 2023

LzLabs, GmBH v. **International Business Machines**
Case IPR2022-01571 (PTAB)
U.S. Patent 7,434,209

Prepared Declaration, February 2023

OTHER CONSULTING

Incentive Systems, Inc.
Event Monitor, Inc.
Coral Networks, Inc.
moka5, Inc.
Global Property Casualty Insurer

Appendix B: Materials Relied Upon

EXPERT REPORTS

1. Expert Report of Joshua Gans, PhD, State of Texas et al., v. Google, LLC, Case No. 4:20-cv-00957, June 7, 2024.
2. Expert Report of Jacob Hochstetler, PhD, State of Texas, et al., v. Google, LLC, Case No. 4:20-cv-00957, June 7, 2024.
3. Appendix C to the Expert Report of Jacob Hochstetler, PhD, State of Texas, et al., v. Google, LLC, Case No. 4:20-cv-00957, June 7, 2024.

FILINGS

1. Fourth Amended Complaint, State of Texas, et al., v. Google, LLC, Case No. 1:21-md-03010-PKC, May 5, 2023.
2. Defendant Google LLC's First Amended Responses and Objections to Plaintiffs' Third Set of Interrogatories, The State of Texas, et al. v. Google LLC, 4:20-cv-957-SDJ, May 24, 2024.

PUBLICATIONS

1. Seb Joseph, "DSPs are cracking down on bid duplication," Digiday (May 12, 2020), https://digiday.com/media/dsps-are-cracking-down-on-bid-duplication.
2. Sarah Sluis, "The Trade Desk suppresses bid duplication amid COVID-19 traffic surge," AdExchanger (Apr. 21, 2020), https://www.adexchanger.com/platforms/the-trade-desk-suppresses-bid-duplication-amid-covid-19-traffic-surge.
3. International Conference on Software Engineering, ICSE Home Page, http://www.icse-conferences.org.
4. Keynotes - ICSE 2024, https://conf.researchr.org/attending/icse-2024/keynotes.
5. Protocol Buffers Documentation, https://protobuf.dev/programming-guides/proto2/#assigning.

PRODUCED DOCUMENTS

1. GOOG-AT-MDL-008842383
2. GOOG-DOJ-AT-02471119
3. GOOG-DOJ-03620221

4. GOOG-DOJ-13199952
5. GOOG-DOJ-15193608
6. GOOG-DOJ-13469175
7. GOOG-DOJ-12700489
8. GOOG-DOJ-15472232
9. GOOG-AT-MDL-C-000010412
10. GOOG-AT-MDL-004017319
11. GOOG-DOJ-14952787
12. GOOG-DOJ-15130321
13. GOOG-DOJ-06867901
14. GOOG-DOJ-13221355
15. GOOG-DOJ-13207875
16. GOOG-AT-MDL-003697856
17. GOOG-DOJ-13605152

PRODUCED SOURCE CODE

1. GOOGEDTX-SC-00001
2. GOOGEDTX-SC-00002
3. GOOGEDTX-SC-00003
4. GOOGEDTX-SC-00004
5. GOOGEDTX-SC-00005
6. GOOGEDTX-SC-00006
7. GOOGEDTX-SC-00007
8. GOOGEDTX-SC-00008
9. GOOGEDTX-SC-00009
10. GOOGEDTX-SC-00010
11. *[Bates number skipped]*
12. GOOGEDTX-SC-00012
13. GOOGEDTX-SC-00013
14. GOOGEDTX-SC-00014
15. GOOGEDTX-SC-00015
16. GOOGEDTX-SC-00016
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45. GOOGEDTX-SC-00045
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47. GOOGEDTX-SC-00047
48. GOOGEDTX-SC-00048
49. GOOGEDTX-SC-00049
50. GOOGEDTX-SC-00050
51. GOOGEDTX-SC-00051

*****Note: I also relied upon any other documents and materials cited in this Report and Technical Appendix, but not mentioned in this Appendix B.***

EXHIBIT 7

HIGHLY CONFIDENTIAL

UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF TEXAS

STATE OF TEXAS et al., Plaintiffs vs. GOOGLE LLC, Defendant	Case Number 4:20-cv-00957

CORRECTED EXPERT REBUTTAL REPORT OF DAVID W. DERAMUS, PH.D.

September 9, 2024 – Incorporating October 25, 2024, Errata

HIGHLY CONFIDENTIAL

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I. Introduction

I.A. Qualifications and experience

(1) My name is David W. DeRamus. My business address is 2001 K St., NW, North Building, Suite 500, Washington, DC, 20006. I am a Partner with the economic consulting firm of Bates White, LLC. I have been in this position since 1999. During this time period, I have served as a testifying and consulting economic expert on a wide range of litigation and non-litigation matters, including matters related to antitrust, class certification, mergers and acquisitions, market manipulation, intellectual property disputes, international trade, tax and transfer pricing, contract disputes, investment disputes, other commercial litigation and arbitration matters, and a variety of proceedings related to the energy industry. Much of my work on litigation matters has involved estimating damages; valuing companies or assets (including technology); and various other financial analyses. From 1998 to 1999, I was employed by the management consulting firm of A.T. Kearney. From 1993 to 1998, I was employed by the accounting firm of KPMG Peat Marwick. In both firms, I performed a variety of economic and statistical analyses related to litigation and non-litigation matters. I received a Ph.D. in Economics from the University of Massachusetts at Amherst, with a specialization in Industrial Organization and International Economics. My Curriculum Vitae is attached as Appendix A. Bates White is being compensated for my time on this matter at the rate of $1250 per hour. This compensation is not contingent on the outcome of the case.

I.B. Scope of charge

(2) I was retained on August 14, 2024, by the Lanier Law Firm. I signed the protective order on that same day. I was asked by counsel for the State of Texas and other Plaintiff States to evaluate and respond to the reports of Dr. Steven Wiggins and Dr. Douglas Skinner, filed on behalf of Google, LLC ("Google" or "Defendant").[1] In particular, I have been asked to respond to their arguments regarding, and quantification of, the relevant scope and extent of Google's conduct at issue; the appropriate financial metrics that should be applied in evaluating that conduct; and the appropriate penalty amounts, if any, that should be applied to Google, in the event that the jury finds that it has engaged in the conduct alleged in the complaint and that the alleged conduct constitutes a violation of the relevant statutes. In responding to Dr. Wiggins and Dr. Skinner, I was asked to focus my analysis on the amount of the monetary penalty, both on a per violation and aggregate basis, that would be

[1] Expert Report of Douglas Skinner, July 30, 2024 [hereinafter "Skinner Report"] and Expert Report of Steven N. Wiggins, July 30, 2024 [hereinafter "Wiggins Report"].

necessary to deter the conduct at issue, either by Google or by another party in the future. It is my understanding that deterrence is one of the factors that the jury should consider in assessing the appropriate penalty amount under the relevant statutes of the Plaintiff States, such as the Texas Deceptive Trade Practices Act ("DTPA").[2]

(3) The primary focus of my response to Dr. Wiggins and Dr. Skinner is on the appropriate penalty amounts if the jury finds that Google engaged in unfair, false, deceptive, and misleading business practices related to its display advertising technology products ("Ad Tech products") and the changes it made to the auctions for display ads from at least 2013 to the present, as alleged by the Plaintiff States. It is also my understanding that the Plaintiff States allege other causes of action, including violations of the federal antitrust laws and similar state statutes related to unfair competition. While I take into consideration issues related to Google's market power and the impact of its conduct on competitors, my opinion on the appropriate penalty amount necessary for deterrence is not dependent on a jury finding of liability for the Plaintiff States' antitrust claims.

(4) In performing my analysis, I have relied on a wide range of information, including the information in the cited expert reports, other documents and data produced in discovery, deposition testimony, and publicly or commercially available research. The materials on which I rely are listed in Appendix B. I reserve the right to supplement in the event of the production of additional data or additional expert testimony from Google. I also reserve the right to use graphics, figures, and/or illustrations at trial to depict conclusions. I further reserve the right to supplement with additional bases for my opinions.

I.C. Summary of opinions

(5) In formulating my responses to Dr. Wiggins and Dr. Skinner, I assume that the jury finds Google to have engaged in the alleged deceptive conduct at issue, and that it finds such deceptive conduct to constitute violations of the relevant statutes of the Plaintiff States. Given this assumption, my analysis is focused on estimating the amount of the monetary penalty, consistent with statutory guidelines, that would be sufficient to deter the conduct at issue. I understand that the ultimate

[2] *See,* e.g., Texas Deceptive Trade Practices Act, accessed May 29, 2024, https://statutes.capitol.texas.gov/Docs/BC/htm/BC.17.htm, Sec. 17.47(g)(3) ("In determining the amount of penalty imposed under Subsection (c), the trier of fact shall consider […] the amount necessary to deter future violations." Additional factors cited in Sec. 17.47(g) are discussed below) ; *see also* Utah Consumer Sales Practices Act, Sec. 13-11-17 (factors considered in assessing appropriate civil penalties include "the need to deter the supplier or other suppliers from committing the violation in the future"); *State ex rel. Wilson v. Ortho-McNeil-Janssen Pharm., Inc*., 777 S.E.2d 176, 203 (S.C. 2015) (case law providing factors including "the deterrence value of the assessed penalties"). *See* Section II.A for further discussion of the Plaintiff States DTPAs.

determination of the penalty amount is an issue for the jury, and that the jury may consider a range of other factors in that determination. In summary, I conclude as follows:

(6) Dr. Wiggins suggests a range of total penalty amounts of between $22 million and $141 million,[3] although he ultimately concludes that the appropriate penalty is zero.[4] These amounts are inconsistent with the scope of the conduct at issue (see Section III); do not reflect the types of harm caused by the conduct at issue (see Section III.D); do not reflect the benefits obtained by Google from the conduct at issue (see Section IV); do not reflect the extent of the conduct at issue (see Section V); and are insufficient to deter Google, or other parties, from engaging in similar conduct in the future (see Section VI). Dr. Wiggins comes to his conclusion by: (i.) focusing narrowly on a subset of the Google products affected by the conduct at issue; (ii.) assuming, without any empirical basis, that sophisticated publishers and advertisers would have been able to avoid much, if not all, of the harm that otherwise would have resulted from the conduct at issue; (iii.) ignoring the broader harm caused by the conduct, including harm to publishers, advertisers, competitors, the competitive process, and consumers; (iv.) narrowly focusing on only a relatively small portion of the benefits obtained by Google from the conduct and ignoring other Google documents showing substantially higher benefits; and (v.) inappropriately reducing the number of affected transactions and statutory violations to 579 billion[5] (which, nevertheless, still constitutes an exceedingly high number of violations).

(7) Dr. Wiggins's analysis does not assess whether the range of penalty amounts he proposes is sufficient to deter Google from engaging in similar conduct in the future. Given the exceptionally large profits generated by Google over the conduct period, the expected continuation of these profits for the foreseeable future, and the broad scope of commerce affected by the conduct, it is unreasonable to expect Dr. Wiggins's proposed penalty amounts to have any deterrent effect on Google, or other similarly situated companies. Similar fines, and even considerably larger fines, imposed on Google in the past have not deterred Google from engaging in this or similar conduct in its other product areas (see Section VII). Dr. Skinner similarly errs in his analysis of the revenues and profits of Google's businesses affected by the conduct at issue; and in his critique of Mr. Andrien's analysis of the impact of a potential $29 billion monetary penalty on Google's financial condition and operations (see Section VIII).[6]

(8) Dr. Wiggins's conclusions are predicated on his overly narrow focus on the amount of operating profits Google earned in a subset of the Plaintiff States from the conduct at issue.[7] Dr. Wiggins

3 Wiggins Report, Figure 6.

4 Wiggins Report, ¶ 19.

5 Wiggins Report, Figure 1.

6 Skinner Report, ¶¶ 59, 65.

7 Wiggins Report, ¶¶ 16, 116.

ignores the fact that under many of the relevant Plaintiff States' statutes at issue, the Plaintiff States are entitled not only to a disgorgement of Google's profits from the alleged conduct, or to a recovery of the damages caused by that conduct, but also to statutory penalties based on the number of violations. It is my understanding that states often adopt statutory penalties when harm from certain conduct is real, but difficult to quantify. The relevant statutes specify a range of potential per-violation penalty amounts, with maximum penalty amounts typically well above $1,000 per violation. For example, the Texas, Arkansas, Florida, Mississippi, and Montana DTPAs specify a maximum of $10,000 per violation.[8] Thus, applying Dr. Wiggins's estimate of 579 billion violations by $1,000 (the lower end of the maxima specified in the relevant Plaintiff States' statutes) would still result in a penalty of $579 trillion, i.e., a sum far in excess of U.S. GDP and sufficient to easily bankrupt Google. None of the relevant Plaintiff States' statutes limit the determination of the penalty amount to a disgorgement of profits, as Dr. Wiggins assumes in his calculations. On the contrary, those statutes that specify the factors that are to be considered in setting the appropriate per-violation penalty amount include a range of factors that Dr. Wiggins either does not consider adequately, such as the scope and severity of the conduct, or at all, such as deterrence.

(9) "The amount necessary to deter future violations" is one of the factors that the Texas DTPA, and similar statutes and case law providing guidance in the other Plaintiff States, specify for determining the appropriate per violation penalty amount; and this factor is the primary focus of my responses to Dr. Wiggins and Dr. Skinner (see Section VI). From an economic perspective, for a monetary penalty to constitute adequate deterrence, at a minimum, the amount must take into account not only the expected total (i.e., global) long-term benefits of the conduct to Google; but also the *ex ante* probability of detection and enforcement. Thus, the minimum deterrent amount will generally be many multiples of the expected total benefits of the conduct.

(10) This conclusion regarding deterrence – that one needs to consider the probability of detection and enforcement, as well as the amount of both total benefits and harms – is extensively supported by the economic literature (see Section II.B). In their reports, neither Dr. Wiggins nor Dr. Skinner considers the probability of detection and enforcement, the expected total benefits to Google of the conduct, or the broader harm of the conduct. In this instance, an even larger penalty amount may be optimal from a deterrence perspective than simply incorporating the probability of enforcement and detection, given the substantial cost of enforcement; the limited resources of relevant enforcement agencies (such as the Plaintiff States' Attorneys General); the exceptionally high profitability and large financial resources of Google; and the extent and severity of the conduct at issue, including the harm of the conduct to publishers, advertisers, the competitive process, and ultimately consumers.

[8] Expert Report of Jeffrey S. Andrien, June 7, 2024 [hereinafter "Andrien Report"], Table 3.

(11) Additional support for a large deterrent penalty amount, relative to the total expected or actual benefits obtained by Google, is found in the extensive "principal-agent" economic literature (see Section II.C). The economic literature has long recognized that there can be divergent incentives between a company's "principals," i.e., its shareholders, and their "agents," i.e., the managers charged with acting on the shareholders' behalf to maximize the value of the company. Dr. Wiggins and Dr. Skinner fail to account for this factor when coming to their conclusions regarding the appropriate penalty and the potential impact of a penalty on Google's stock price. In this case, the conduct at issue was developed and implemented by Google's management; but the penalty amount will most likely be borne disproportionately (if not entirely) by current shareholders. For conduct of the type and scope at issue here, in order for a penalty amount to significantly deter management's actionable conduct, the penalty needs to be sufficiently large to affect the company's stock price, so that shareholders, in turn, have the incentive to direct a change in management's conduct. Absent that sufficiently strong market "signal," shareholders have little or no incentive to change management's conduct, as the benefits that they can expect to gain from that conduct are likely to continue to be greater than their costs. Thus, all else equal, the principal-agent literature suggests that for a given penalty amount to have a deterrent effect, it needs to be larger for a publicly owned company than a privately owned company; and it needs to be larger, the larger the company's size, the larger the amount of its profits, the larger its market capitalization, and the faster its growth. If the penalty is not sufficiently large to be detectable by a company's shareholders relative to the myriad of other factors that affect a company's stock price, managers will have an incentive to engage in actionable conduct that increases the company's short-term profits (insofar as those lead to increases in management's compensation) without being disciplined by shareholders if and when penalties are imposed for that behavior in later years.

(12) To determine the amount necessary for deterrence, given the exceptionally large number of violations at issue, from an economic perspective the appropriate method for establishing the relevant per-violation penalty amount is to: *first*, establish the aggregate deterrent amount ("$D"), based on a broader assessment of the overall scope, extent, total benefits, and total harms of the conduct, adjusted for the probability of detection and enforcement, as well as other factors, consistent with the well-established principles developed in the economic and finance literature on this topic; *second,* divide the aggregate deterrent amount by the number of statutory violations ("n"); and *third,* select the minimum of either: (a.) the maximum per penalty amount (i.e., $10,000 in the case of the Texas DTPA); or (b.) $D/n. Thus, if Google committed 579 billion statutory violations, as Dr. Wiggins calculates, and the aggregate deterrent amount is between $7.3 billion and $21.8 billion (using a range provided by Mr. Andrien),[9] the appropriate per penalty amount is $0.013 - $0.038 per violation; which is still far below the statutory maximum penalties per violation, but far above the amount assumed by Dr. Wiggins. From an economic perspective, this implies that once

[9] Andrien Report, ¶ 11, point h.

the number of statutory violations grows to a very large number, the overall violation count becomes less relevant in determining the appropriate aggregate penalty amount, given the large maximum per penalty amounts available under the statutes (see Section II.B). Given the scale of Google's conduct, whether the relevant number of statutory violations is 579 billion, as Dr. Wiggins concludes, or many trillions, as Mr. Andrien concludes, does not change the aggregate penalty required to deter the conduct.

(13) To address Dr. Wiggins's failure to account for deterrence in deriving an appropriate penalty amount, I apply the framework from the relevant economic and finance literature to the facts of this case. The first factor I analyze is the scope and severity of the harm likely caused by the conduct at issue, placing the conduct within the specific context of the products and structure of the Ad Tech industry (see Section III). While severity is listed as a separate factor to be considered in some of the Plaintiff States' statutes, from an economic perspective, the overall scope and severity of the conduct at issue – i.e., the type of impact that it had on publishers, advertisers, Google, Google's competitors (in each of the relevant product markets), and ultimately, consumers – is also relevant in assessing the appropriate aggregate deterrent amount. This is because the scope and severity of the conduct are likely to reflect the broader harm of the associated conduct, as well as its potential benefits to Google.[10] Based on my review of the information in this case, I conclude that the actual and potential total benefits to Google go well beyond the limited incremental profits that Dr. Wiggins calculates; and that the total long-term harm to publishers, advertisers, competition, and ultimately consumers is likely well in excess of Google's total benefits to date. I further conclude that the scope of the conduct at issue likely affected a broader range of Google's products than Dr. Wiggins assumes in his analysis, including Google's in-app products; Google's other Ad Tech products that are integrated into, and interdependent with, Google's display advertising "ecosystem;" and potentially including advertising on Google's own properties (e.g., YouTube, Gmail, or Search) via its effect on AdWords, for example.

(14) The second factor I consider is the total volume of commerce likely affected by the conduct at issue (see Section IV). Dr. Wiggins focuses his penalty analysis solely on his estimate of incremental profits, and solely on the transactions he allocates to the Plaintiff States. In contrast, to determine an appropriate deterrent penalty, I consider it important to assess the full extent of the conduct at issue—i.e., the total volume of commerce affected by that conduct. The volume of commerce affected can be measured by the amount of Google's booked revenues affected by the conduct,

[10] For example, if Google were a small player selling a discrete and separable product in a very large market, and the conduct at issue allowed it to earn one additional penny on a small volume of sales, and that additional penny of sales came solely at the expense of publishers, for which it constituted an exceptionally small fraction of their revenue and profits, it is unlikely that the scope of benefits obtained by Google was in excess of that incremental penny; or that the harm to the publishers resulting from the conduct was greater than the amount of Google's benefit; or that the conduct would likely lead to additional long-term benefits to Google or long-term harm to others.

which provides one indication of the potential severity of the conduct, its potential amount of harm, and its range of potential benefits to Google. I also analyze the amount of Google's net revenue, gross profits, and operating profits that were likely affected by the conduct. In his analysis, Dr. Wiggins focuses narrowly on a subset of Google's Ad Tech products at issue.[11] In contrast, I review the revenues and profits for Google's total Ad Tech business, as reported in its Display & Video, Apps, and Analytics ("DVAA") financial schedules, as I expect the conduct affected all the products included in that business. In my assessment, I also consider the revenues and profits of Google's business segments, Google Network and Google Websites, as reported in the company 10-Ks. The amount of Google revenues and profits for these businesses are large (see Section IV). Total booked revenue for the period at issue is [redacted] for Google's Ad Tech (DVAA) business, i.e., for those products most clearly affected by the conduct; to the extent that the conduct also affected other Google Network revenues, the total affected booked revenues would increase to $224 billion; and if the conduct affected advertising on Google's own properties, it would affect an additional $1.15 trillion in booked revenues.[12] Corresponding total operating profits are [redacted] for Ad Tech (DVAA), [redacted] for Google Network, and approximately [redacted] for Google Websites.[13] While there are important conceptual issues associated with how the affected revenues and profits should be allocated to the Plaintiff States, I adopt Mr. Andrien's conservative approach.[14] Although it likely significantly understates the volume of commerce associated with the Plaintiff States, this allocation results in total booked revenue allocated to the Plaintiff States of [redacted] for DVAA, $30.7 billion for Google Network, and $159.0 billion for Google Websites during the period at issue; and total operating profits allocated to the Plaintiff States of [redacted] for DVAA, [redacted] for Google Network, and [redacted] for Google Websites.[15]

(15) The third factor I evaluate is the extent of the conduct at issue as measured by the number of affected transactions (see Section V). Dr. Wiggins contends that the number of affected transactions in the Plaintiff States is 579 billion. Dr. Wiggins fails to distinguish between the number of total affected transactions ("N") and the number of potential statutory violations ("n"), both of which are relevant for determining appropriate deterrent penalties. The former ("N") is relevant in assessing the full scope, extent, potential harm, and potential benefits of the conduct; while the latter ("n") is used to derive per-penalty amounts (up to the relevant statutory maximum). I also disagree with several of Dr. Wiggins's "corrections" of Mr. Andrien's number of affected transactions, such as his "correction 2," which eliminates in-app transactions. It is my understanding that AdX is also used for in-app advertisements, and thus, these transactions would have been affected by the conduct at

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[11] Wiggins Report, ¶ 112.

[12] *See* Section IV.

[13] *See* Section IV.

[14] Andrien Report, ¶¶ 93–94.

[15] *See* Section IV.

issue. Based on the figures in Dr. Wiggins's report, I estimate the total number of affected transactions ("N") to be between 19 trillion and 98 trillion globally. With regard to the number of statutory violations ("n"), I estimate that the number of *transactions* subject to statutory penalties is likely between at least 739 billion and 3.6 trillion; while the number of potential statutory *violations* ("n") could be between 974 billion and 7.7 trillion, depending on whether the jury considers each of the programs as applied to each transaction to be separate violations; or if it limits the number of statutory violations to at most one per transaction. Even if one were to accept Dr. Wiggins's number of violations of 579 billion, however, the number is so large that it does not change the appropriate deterrent penalty amount, which should be derived first on an aggregate basis, and then converted to a per violation amount by simply dividing it by the number of statutory violations that the jury ultimately determines.

(16) Contrary to Dr. Wiggins's unsupported conclusions that Google's conduct had a minimal, if any, impact on either Google or the Ad Tech industry participants,[16] my analysis of the scope of the conduct, the affected industry, the likely types of harm, the volume of commerce affected, the number of affected transactions, and the benefits to Google all strongly indicate that a penalty in this case would need to be quite large to have an appropriate deterrent effect. I then turn to estimate an appropriate deterrent penalty (see Section VI). To do so, I first review Dr. Wiggins's penalty estimates of between $21.7 million and $141.3 million based on his estimate of Google's incremental benefits (see Section VI.A). None of Dr. Wiggins's penalty amounts are derived using a method appropriate for determining a deterrent amount, as he fails to account for the probability of detection and enforcement; nor are they consistent with the benefits that Google expected to obtain, and did obtain from the conduct at issue, as reflected in multiple Google's contemporary documents. For example, in 2015, Google employees estimated that Project Bernanke allowed the company to earn [redacted] of incremental revenues on an annualized basis. Other Google documents estimate that its DRS and RPO programs each enabled it to earn an additional [redacted] in incremental revenues. Since these programs were expected to continue into the future, I perform my calculations using two alternative growth rates, applying 3 percent and 5 percent annual growth rates[17] to the incremental profits associated with the projected incremental revenues from these programs to derive the total *ex ante* expected value of their benefits to Google. I also review a range of data sources suggesting that reasonable estimates of the *ex ante* probability of detection, enforcement, and collection of penalties is between no more than 33 percent and 10 percent. Dividing the *ex ante* expected value of the benefits by these probabilities results in a range of deterrent penalties of between $14.8 billion and $124.4 billion as of June 2025;[18] or between $10.7 billion and $75.9 billion, assuming a 20-year limited duration of the expected benefits. The width of

16 Wiggins Report, Figure 6 and ¶ 19.

17 These growth rates are considerably less than Google's prior or projected future growth rates at the time.

18 June 2025 is the earliest date on which I assume Google would pay a penalty in this case.

these ranges largely reflects the use of probabilities of between 33 percent and 10 percent (i.e., expected benefit multipliers of between three and ten). I also derive deterrent penalties using an *ex post* approach by estimating Google's benefits during the years at issue, and scaling those benefits to its actual growth in Ad Tech revenues. Applying the same probabilities as in the *ex ante* approach results in deterrent penalties of between $9.6 billion to $43.7 billion. A reasonable fact finder could determine that the appropriate penalty is within these ranges or, potentially, even higher.

(17) As discussed above, Dr. Wiggins and Dr. Skinner fail to address the role of principal-agent issues in determining a deterrent penalty. To address this omission and as an alternative method for deriving a deterrent penalty, I analyze prior financial market reactions to fines previously imposed on Google (see Section VII.A). For example, Google has previously been assessed fines or settlements more than 48 times, of which 18 were in the US, 18 in the EU — including fines of approximately $9.5 billion in Europe during 2017 – 2019 for similar conduct — and 12 in other regions of the world. Despite this, the financial markets had little reaction to these fines (Section VII.B). For a penalty to be sufficiently large for shareholders to require a change in management conduct, i.e., in order for the penalty to have a deterrent effect on management's future conduct, it needs to be sufficiently large to be detectable by shareholders, relative to the myriad of other factors that cause daily fluctuations in the company's stock price. My econometric analysis of the impact of Google's prior fines on its stock price further confirms my conclusion that penalties in the magnitudes of those that have been assessed previously against Google have had little to no measurable impact on its stock price. Based on that analysis, I conclude that a penalty amount in this case of between $12 and $25 billion, and likely higher, is required to have a deterrent effect on Google's future conduct, as well as the conduct of potentially similarly situated companies, particularly given the profitability of the conduct at issue. These penalty amounts, and those I derive above, do not take into account other factors that the relevant statutes specify should be considered in the jury's ultimate determination.

(18) Finally, I disagree with Dr. Skinner regarding the financial impact on Google (or its parent company, Alphabet) of a $29 billion potential penalty evaluated by Mr. Andrien.[19] From my analysis, I conclude a deterrent penalty of $50 billion is unlikely to cause Google financial difficulties, limit its ability to invest in research and development ("R&D"), make capital expenditures, engage in mergers and acquisitions, limit its access to capital, or otherwise interfere with Google's day-to-day operations (see Section VIII). Relevant Google financial measures as of the end of 2023 that I consider in coming to this conclusion include the following:

- Google had cash and short-term equivalents on hand of $110.9 billion;
- it generated $101.7 billion in free cash flow from operations in 2023 alone;

[19] Skinner Report, Section X.

- it had available credit lines of $10 billion and very limited total debt (including long-term leases) of $29.9 billion, indicating a substantial amount of available borrowing capacity well above $50 billion;
- it had a market capitalization of about $1.8 trillion (and over $2 trillion currently); and
- over the past 9 years, it has spent $240 billion in repurchasing its own shares (through 2023), with not yet executed stock buybacks after 2023 including the additional authorized buyback (since 2024) of $106 billion.

(19) The remainder of my report is organized as follows. In response to Dr. Wiggins's and Dr. Skinner's opinions, in Section II, I first provide the economic framework to be used in determining an appropriate deterrent penalty amount. I then apply that framework to the relevant issues in this case. To do so, in Section III, I review the scope of the conduct at issue, including the various products and markets likely affected by the conduct; as well as the types of harm to society and benefits to Google that likely resulted from the conduct. In Section IV, I analyze the extent of the conduct at issue, focusing first on the volume of commerce, including Google's revenues and profits not only from its Ad Tech business, but also from its broader advertising business that may have been affected by the conduct. In Section V, I analyze the global number of advertising transactions likely affected by the conduct ("N") and the number of potential statutory violations ("n") in the relevant Plaintiff States. In Section VI, I review Dr. Wiggins's estimate of Google's incremental benefits from the conduct. Then, based on estimates of Google's incremental benefits derived directly from various Google documents, and applying a reasonable range of probabilities of detection and enforcement obtained from my research, I derive a range of deterrent penalty amounts, consistent with the guidance provided by the economic and finance literature. In Section VII, I derive an alternative estimate of deterrent penalties, using a methodology consistent with the guidance provided from the principal-agent literature, based on a statistical analysis of the financial market impact of prior penalties imposed on Google. Lastly, in Section VIII, I examine whether a deterrent penalty of $50 billion is likely to result in "overdeterrence," by either significantly impairing Google's financial condition; limiting its ability to finance capital expenditures, R&D activities, or mergers and acquisitions; or otherwise impinging on its day-to-operations.

II. Economic framework for determining statutory penalties with a deterrent effect

(20) Dr. Wiggins's framework for assessing the appropriate penalties for the conduct at issue fails to consider all the relevant economic considerations, particularly those relevant for determining an

appropriate deterrent penalty.[20] As I discuss in detail below, Dr. Wiggins omits a discussion of key factors in determining the economically appropriate magnitude of a penalty; he narrowly focuses on AdX rather than on all the products affected by the conduct; and he only considers as relevant those transactions that he narrowly determines are "linked to the alleged deception."[21] The sections below address the flaws in Dr. Wiggins's analysis. In this section, I discuss the economic considerations identified by the economic and finance literature that are relevant in determining appropriate penalties that would likely have the effect of deterring similar conduct in the future, whether by Google or by other parties. In subsequent sections, I discuss the scope of the alleged conduct, the types of harm that likely resulted from the alleged conduct, and the implication of that scope and harm for the relevant products affected by the alleged deception.

II.A. Alternative approaches to determining monetary remedies

(21) There are various approaches to determining monetary remedies in a litigation context, depending on the statute, the plaintiff, the defendants, and the claimed harm. One approach may be to calculate the benefits obtained by the defendant as a result of the conduct, such as in a plaintiff's claim for the disgorgement of a defendant's profits resulting from the infringement of the plaintiff's patents. In other contexts, a plaintiff may seek recovery of their monetary damages. In a price-fixing case, for example, a plaintiff purchaser may have paid prices for a particular input that were elevated by the price-fixing agreement; thus, an appropriate measure of damages may be calculated by first estimating the price that the plaintiff would have paid "but for" the alleged conduct, and then calculating the plaintiff's damages based on the amount of the price differential multiplied by the plaintiff's volume of purchases. In yet other contexts, a plaintiff may seek to recover the profits that they would have earned, or the lost value of their business, as a result of the defendant's conduct at issue, such as in the event of conduct that forced a plaintiff competitor to exit a relevant market and allowed the defendant to monopolize it. In yet other instances, such as in a contract-related dispute, a plaintiff may seek monetary relief based on the full rescission of the contract, with a complete repayment of all revenues paid by the plaintiff or monies received by the defendant.[22]

(22) Note that a defendant's benefit (e.g., the incremental profit earned by a chemical company from making a product) may not equal the harm to the plaintiff (e.g., the disruption to a purchaser's business if a chemical was defective) or to other parties (e.g., the physical harm to consumers exposed to a toxic chemical spill). Certain statutes may also allow for the recovery of a multiple of

[20] Wiggins Report, § III.B.

[21] Wiggins Report, ¶ 104.

[22] For a general review of alternative approaches for calculating monetary remedies, see, e.g., Roman Weil, Daniel Lentz, and David Hoffman (eds.), *Litigation Services Handbook: Role of the Financial Expert*, John Wiley & Sons, Inc., 2012, Fifth Ed.; Hoboken, NJ, pp. 4.11 – 4.21.

damages, such as treble damages in the case of certain antitrust violations, or punitive damages in other contexts.[23] It is my understanding that the purpose of treble damages in the antitrust context, and to a certain extent punitive damages, is to deter the conduct at issue, both with regard to the defendant and other parties.[24]

(23) In response to Dr. Wiggins and Dr. Skinner, I have been asked to focus on the civil penalties sought by the Plaintiff States' claims based on certain Plaintiff State statutes, such as the Texas DTPA, which allow for the award of statutory penalty amounts for deceptive conduct. These statutory penalties are assessed on a per-violation basis, with the statutes often specifying a maximum penalty amount per violation, as in the Texas DTPA, which has a maximum of $10,000 per penalty.[25] It is my understanding that civil penalties are often applied to statutory violations when the harm resulting from a given course of conduct is real, but difficult to quantify; or when the purpose of the statute is to punish the wrongdoer and/or to deter similar conduct in the future, rather than simply restore the status quo, as with the disgorgement of unlawful gains, which may be an insufficient remedy or deterrent for the unlawful conduct.[26] With civil penalties, the amount of the penalties can be calibrated to deter the wrongful conduct.[27]

(24) While each statute with civil penalties may provide different levels of guidance with respect to how the amount of the penalty should be calculated (including, in some instances, no specific guidance), those that do specify which factors to apply often provide a relatively broad set of factors. For example, the Texas DTPA provides the following guidance for how an appropriate penalty amount should be determined:

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[23] *See*, e.g., Indiana Code § 24-5-0.5-4 (2023), which states that the court "may increase damages for a willful deceptive act in an amount that does not exceed the greater of: (1) three (3) times the actual damages of the consumer suffering the loss; or (2) one thousand dollars ($1000)," in an action brought by "a person relying upon an uncured or incurable deceptive act;" Nevada Rev State § 598.0971 (2023), which permits the imposition of "an administrative fine of $1,000 or treble the amount of restitution ordered, whichever is greater;" North Dakota Century Code § 51-15-09 (2023), which states that "if the court finds the defendant knowingly committed the conduct, the court may order that the person commencing the action recover up to three times the actual damages proven;" South Carolina Code § 39-5-50 (2023), which states that the court "shall award three times the actual damages sustained" in an action brought "individually" by "any person who suffers any ascertainable loss of money or property… as a result of the use… of an unfair or deceptive method;" and Texas Code § 17.50 (2023), which similarly provides for treble damages for "mental anguish." *See also* 15 U.S.C. § 15 (2023) and 18 U.S.C. (1964) for examples of federal laws allowing for treble damages.

[24] *See*, e.g., Steven C. Salop & Lawrence J. White, Economic Analysis of Private Antitrust Litigation, 74 GEO. L.J. 1001, 1051 (1986). The Supreme Court noted that the fear of treble damages creates "a crucial deterrent to potential violators." (Mitsubishi Motors Corp. v. Soler Chrysler-Plymouth, Inc., 473 U.S. 614, 635).

[25] *See* Andrien Report, §§ III.E and IV.E, and his Table 3 for a summary of the maximum penalty per violation.

[26] Rohit Chopra and Samuel A. A. Levine, "The case for resurrecting the FTC Act's penalty offense authority." *University of Pennsylvania Law Review*, Vol. 170: 71, 2021, p. 81; § II.A; and § II.B.

[27] Rohit Chopra and Samuel A. A. Levine, "The case for resurrecting the FTC Act's penalty offense authority." *University of Pennsylvania Law Review*, Vol. 170: 71, 2021, § III.B.1.

> In determining the amount of penalty imposed under Subsection (c), the trier of fact shall consider: (1) the seriousness of the violation, including the nature, circumstances, extent, and gravity of any prohibited act or practice; (2) the history of previous violations; (3) the amount necessary to deter future violations; (4) the economic effect on the person against whom the penalty is to be assessed; (5) knowledge of the illegality of the act or practice; and (6) any other matter that justice may require.[28]

(25) I understand that other Plaintiff States have similar criteria in their relevant statutes and/or case law.[29] Common to these statutes and case law is that the deterrence of future violations is a key criterion, as under factor (3) in the Texas DTPA.[30] Accordingly, the focus of my analysis in response to Dr. Wiggins is on estimating an appropriate penalty amount in this case that will likely deter Google and other parties from engaging in similar conduct in the future. It is my understanding that it is up to the jury to determine the actual penalty amount and that in making its determination, the jury may need to consider a broad range of factors in addition to deterrence, such as those additional factors identified above in the Texas DTPA. While some of those other factors may be relevant to analyzing deterrence from an economic perspective (such as identifying the actual or potential harm based on the seriousness and extent of the violations, or evaluating the economic effect on the defendant), the jury may consider those other factors from a different perspective as well, i.e., increasing or decreasing the per-violation penalty amount based on the jury's assessment of the relative importance of those factors.

(26) I draw three primary conclusions from the above discussion. First, there is no reason to limit an assessment of the appropriate penalty amount to the amount of the incremental profit obtained by the defendant, as Dr. Wiggins assumes in his analysis, particularly because that is not one of the six factors specified under the Texas DTPA, for example. Second, given the wide range of factors that the jury may consider, there is a wide range of economic and financial information that may be relevant to the jury, including not only a broad overview of the types of actual or potential harm caused by the conduct, but also information related to Google's overall financial performance, its market

28 Texas Deceptive Trade Practices Act § 17.47(g).

29 *See also* Andrien Report, § III.E, for an overview of States' deceptive trade practice statutes.

30 *See,* e.g., Texas Bus & Com Code § 17.47 (2023) and Utah Code § 13-11-17 (2023), where the amount of penalty is to be determined by, among other factors, the "amount necessary to deter future violations." The relevant statutes of six other plaintiff states authorize courts to award other "orders or judgments as may be necessary to prevent the use or employment by a person of any method, act or practice declared to be a violation," or similar language on the importance of prevention of future use, whether by the defendant or by another person, of deceptive trade practices in the future; *see,* e.g., Arkansas Code § 4-88-113 (2023), Idaho Code v 48-607 (2023), Mississippi Code § 75-24-19 (2023), Nevada Rev Stat § 598.0979 (2023), North Dakota Century Code § 51-15-07, and South Carolina Code § 39-5-50 (2023). I understand that case law on actions brought under these and other sections of the statutes has further underscored the importance of preventative measures in enforcement.

capitalization, its aggregate revenues and profits, its total revenues and profits from its Ad Tech business at issue, whether it has engaged in similar conduct in other markets, the amount of fines or civil penalties that have been assessed against it in the past, etc. – i.e., much of the information in Mr. Andrien's report that Dr. Wiggins and Dr. Skinner claim is irrelevant in determining the appropriate penalty amount. Third, because all these statutes specify that the penalties are assessed on a per-violation basis,[31] it is necessary to assess both the total penalty required for deterrence and the appropriate per-violation penalty.

II.B. The economics of deterrence and statutory penalties

(27) The economic literature on deterrence focuses on the role of penalties in altering the balance of expected benefits and expected costs of violations.[32] Deterrence requires a credible threat of penalties that weighs sufficiently in the balance of expected costs and benefits. The basic considerations that matter for deterrence are: (i.) the costs to society from the conduct that the penalty is meant to prevent (and that the offender should internalize); (ii.) the gains to the offender, which matter for the offender's cost-benefit analysis; and (iii.) the probability of detection and enforcement.[33]

(28) The basic intuition of the economic approach to deterrent penalties is that social welfare equals the gains individuals obtain from committing the harmful act, less the harm caused, less the enforcement costs. For a fixed probability of enforcement, the optimal penalty is equal to the harm caused by the violation divided by the probability of enforcement.[34] Moreover, an individual will commit the harmful act if and only if their gain from doing so exceeds the expected penalty. Hence,

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31 *See* Andrien Report, § III.E., for a detailed overview of the relevant statutes and Table 3 for a summary of the maximum penalties able to be awarded per violation.

32 For surveys of the literature see, e.g., Steven Shavell and A. Mitchell Polinsky, "The Theory of Public Enforcement of Law." In the Handbook of Law and Economics, Vol. 1, A. Mitchell Polinsky and Steven Shavell (editors), *Elsevier*, 2007, Chapter 6; Paolo Buccirossi, Lorenzo Ciari, Tomaso Duso, Giancarlo Spagnolo, and Cristiana Vitale, "Deterrence in Competition Law," in *Analysis of Competition Policy and Sectoral Regulation*, Martin Peitz and Yossi Spiegel (editors), World Scientific, 2014, Chapter 15; and Wouter Wils, "Optimal Antitrust Fines: Theory and Practice." *World Competition*, Vol 29, No 2, June 2006.

33 *See*, e.g., Roman Weil, Daniel Lentz, and David Hoffman (eds.), *Litigation Services Handbook: Role of the Financial Expert*, John Wiley & Sons, Inc., 2012, Fifth Ed.; Hoboken, NJ, p. 5-1. ("The optimal deterrent award, putting aside punitive issues, should be equal to the ill-gotten gain derived from the unlawful act ***adjusted for the probability that someone will detect the act***." (Emphasis added.) The broader economic literature, cited throughout this section, also focuses on the need to consider the social costs and harm of the conduct as well.

34 The socially optimal penalty makes the offender internalize all the costs and benefits of the violation, thus leading the offender to commit only 'efficient violations,' i.e., those for which the total benefits exceed the total costs, while deterring 'inefficient violations,' i.e., those for which the total costs exceed the total benefits; *see*, e.g., G.S. Becker, "Crime and Punishment: An Economic Approach" (1968) 76 *Journal of Political Economy* 169 and W.M. Landes, 'Optimal Sanctions for Antitrust Violations' (1983) 50 *The University of Chicago Law Review* 652.

deterrence, i.e., ensuring that an individual does not engage in the harmful act, requires that the penalty be greater than at least the gain divided by the probability of enforcement.[35]

(29) For example, assume the wrongdoer expects to gain $100 from a given violation, and there is a 10 percent probability of detection; from an economic perspective, the penalty must be at least $1,000 in order for the penalty to be sufficient to deter the conduct.[36] In many cases, detection is not sufficient to ensure enforcement and the imposition (and collection) of a penalty: enforcement is costly, there are limited enforcement resources, and cases may be dismissed before trial for a variety of reasons. Assume in the immediately preceding example that once actionable conduct is detected, there is still only a 10 percent probability of a successful enforcement action resulting in a penalty being paid. In that event, the deterrent penalty must be greater than $10,000, i.e., $100 divided by 1% (10% probably of detection x 10% probability of enforcement = 1% probability of detection and enforcement). Thus, the amount of a penalty necessary for deterrence will generally be a multiple of the financial benefits to the wrongdoer; and depending on the probability of detection and enforcement, it may be many multiples of those benefits. Moreover, if the harm to society is greater than the gains to the wrongdoer from the violation, social welfare considerations require that the penalty be even larger.[37]

(30) The economics literature provides additional important insights for thinking about the level of penalties required to deter wrongdoing:

- A lower probability of detection and enforcement requires a higher penalty to ensure deterrence. In practice, "because the likelihood of being caught by a law enforcement agency is usually very low, basic deterrence theory indicates that penalties on those who are caught must be severe."[38]
- Since enforcement is costly, it makes economic sense to have relatively large penalties and a low probability of detection.[39]

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[35] Deterrence requires that the penalty > (gain to individual from offence) / (probability of detection and enforcement).

[36] *See also* Chopra, Rohit and Samuel A. A. Levine, "The Case for Resurrecting the FTC Act's Penalty Offense Authority," *University of Pennsylvania Law Review* 170, no. 71 (2021): 100. *See* in particular the examples in fns. 136 and 137.

[37] Anticompetitive conduct creates "deadweight loss," which occurs when markets are out of competitive equilibrium, and therefore the social harm from competition-related violations generally exceeds the gain.

[38] Chopra, Rohit and Samuel A. A. Levine, "The Case for Resurrecting the FTC Act's Penalty Offense Authority," *University of Pennsylvania Law Review* 170, no. 71 (2021): 99.

[39] Steven Shavell and A. Mitchell Polinsky, "The Theory of Public Enforcement of Law," in the Handbook of Law and Economics, Vol. 1, A. Mitchell Polinsky and Steven Shavell (editors), *Elsevier*, 2007, Chapter 6, § 7.

- If gains (or harm) are difficult to determine with certainty, or if the probability of deterrence is uncertain, deterrence generally requires that penalties be higher to guard against the risk of underdeterrence.[40]
- The public imposition of penalties has a deterrent effect because it sends a credible signal that violations will be punished. This is particularly important in the presence of availability bias, which leads people to disproportionately focus on recent and well-publicized incidents; and overconfidence bias, which leads people to systematically underestimate the probability of bad things happening.[41] Appropriate deterrent penalties may also have other beneficial effects, such as reinforcing the commitment of law-abiding people to the rule of law.[42]
- There will be underlying differences in the gains obtained by particular offenders, even for the same type of violation, and hence, the optimal penalty for deterrence is higher for some offenders than others. If a firm (or person) is a repeat offender, then the previous penalty was insufficiently high to deter them, suggesting that the optimal penalty is higher for them.[43]
- If a firm, rather than an individual, is responsible for a violation, this gives rise to "principal-agent" problems and additional considerations,[44] discussed further below.
- Appropriate penalty amounts depend on offenders' financial resources for at least two reasons. First, the risk of "overdeterrence" is lower for those with large financial resources, as discussed further below. Second, firms or people with less financial resources may behave as though they were more risk-averse, for example because they have more limited access to capital markets, or simply because a given penalty amount is more likely to cause financial difficulties (including bankruptcy) for a firm with more limited financial resources. The optimal penalty tends to be lower in the risk-averse case, since the penalty does not need to be as high to achieve the desired degree of deterrence.[45]
- For deterrence to be effective, one needs to assess the total benefits from the conduct to derive an appropriate deterrent penalty, rather than limiting the analysis to only a portion of those benefits. Thus for example, if conduct is implemented on a global basis (as with Google's

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40 Steven Shavell and A. Mitchell Polinsky, "The Theory of Public Enforcement of Law," in the Handbook of Law and Economics, Vol. 1, A. Mitchell Polinsky and Steven Shavell (editors), *Elsevier*, 2007, Chapter 6, §§ 7 and 15; and Wouter Wils, "Optimal Antitrust Fines: Theory and Practice." *World Competition*, Vol 29, No 2, June 2006, §§ I.2.b and II.A.2.

41 Wouter Wils, "Optimal Antitrust Fines: Theory and Practice." *World Competition*, Vol 29, No 2, June 2006, § II.A.

42 Wouter Wils, "Optimal Antitrust Fines: Theory and Practice." *World Competition*, Vol 29, No 2, June 2006, §§ II.B.

43 Steven Shavell and A. Mitchell Polinsky, "The Theory of Public Enforcement of Law," in the Handbook of Law and Economics, Vol. 1, A. Mitchell Polinsky and Steven Shavell (editors), *Elsevier*, 2007, Chapter 6, § 22.

44 A. Mitchell Polinsky and Steven Shavell, "Public Enforcement of Law," in the New Palgrave Dictionary of Economics, Steven N. Durlauf and Lawrence E. Blume (editors), Second Edition, 2008.

45 Steven Shavell and A. Mitchell Polinsky, "The Theory of Public Enforcement of Law," in the Handbook of Law and Economics, Vol. 1, A. Mitchell Polinsky and Steven Shavell (editors), *Elsevier*, 2007, Chapter 6, § 7.2.

conduct at issue), assessing a penalty only based on the benefits obtained within a narrow geographic territory, even adjusting for the probability of enforcement, will not be sufficient to deter the conduct, since the expected benefits from the conduct will exceed its (probability adjusted) expected cost.[46] For the same reason, to determine an appropriate deterrent penalty for conduct that persists over time, one needs to consider the benefits (or social harm) over the entire expected or actual time period of the conduct. Ultimately, the amount of the deterrent penalty will still be limited by the statutes applicable to a given enforcement agency; thus, if only a small number of actionable violations occurred in an enforcement agency's jurisdiction, the amount of the penalty will be limited by the maximum per violation penalty specified in the statute, which may be less than the amount necessary for deterrence.

(31) If the offender is otherwise engaged in socially beneficial activities, "overdeterrence" is a concern, and penalties should account for the offender's continued ability to engage in these socially beneficial activities. For example, very high fines may jeopardize a firm's financial stability or access to capital markets, in which case, a firm may be forced to exit a given market, which in turn may lead to reduced innovation, increased market concentration, decreased competition, and lower consumer welfare. While it is important to consider the risks of overdeterrence in estimating an appropriate deterrent amount, these risks require a number of qualifications: (i.) the risk of general underdeterrence may be more significant than the risk of a few convicted firms being bankrupted by high fines; (ii.) if bankruptcy proceedings are efficient, the costs of bankruptcy may be low; (iii.) penalties exist to deter violations in all industries, suggesting they may need to be higher than might be optimal for just a single firm; and (iv.) "moral hazard" issues may arise, as it may induce firms to undertake actions to reduce their level of expected fines simply by reducing their apparent ability to pay, such as by taking on more debt than is otherwise efficient.[47]

(32) Finally, the total volume of commerce, such as the total revenues or profits earned by the defendant, may be relevant in determining appropriate monetary remedies, depending on the context of the violation. For example, if a mortgage originator fails to perform required underwriting but fraudulently misrepresents to the market that it has, the regulator or enforcement agency may be concerned not just with the incremental profits the lender earned on the loans it should not have issued to poor credit quality borrowers (i.e., the disgorgement of its profits relative to the "but for world"); or with the damages suffered by the ultimate holders of those mortgages (i.e., making whole the holders of defaulted or underperforming loans that would not have been issued in the

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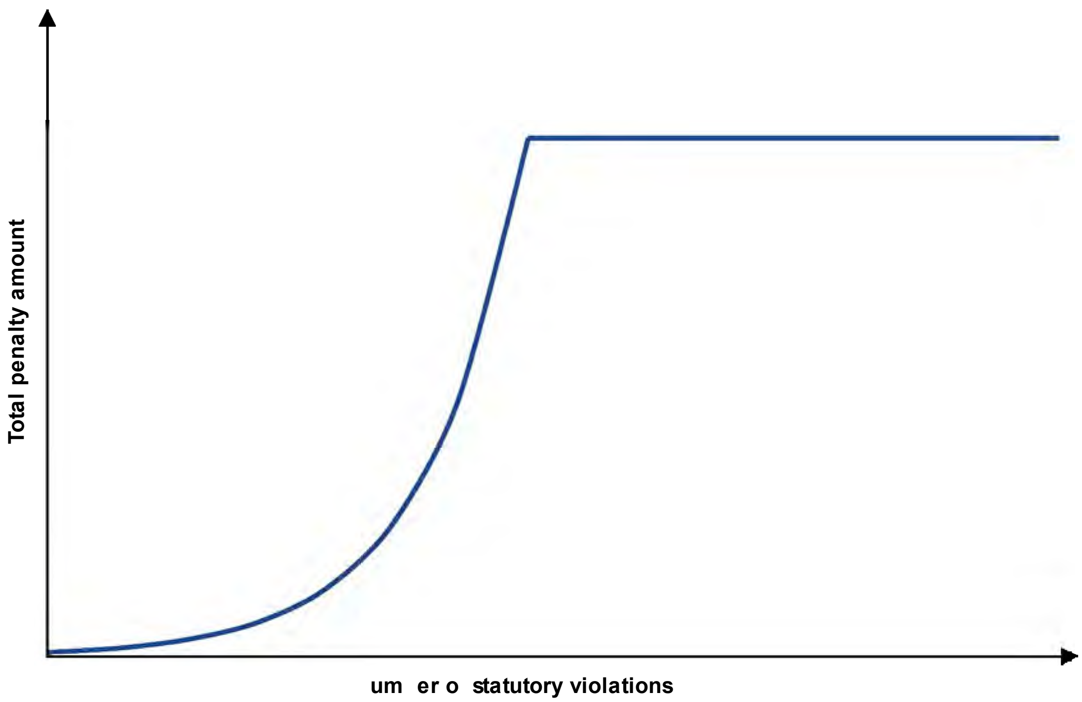
46 Paolo Buccirossi, Lorenzo Ciari, Tomaso Duso, Giancarlo Spagnolo, and Cristiana Vitale, "Deterrence in Competition Law," in Analysis of Competition Policy and Sectoral Regulation, Martin Peitz and Yossi Spiegel (editors), *World Scientific*, 2014, Chapter 15, § 3.1.

47 Paolo Buccirossi, Lorenzo Ciari, Tomaso Duso, Giancarlo Spagnolo, and Cristiana Vitale, "Deterrence in Competition Law." in Analysis of Competition Policy and Sectoral Regulation, Martin Peitz and Yossi Spiegel (editors), *World Scientific*, 2014, Chapter 15, § 2.4.

"but for world"); but they may also be concerned about the total revenues or profits earned by the mortgage originator from all its unlawful originating activity, regardless of the incremental benefits received or harm caused, as all its revenues and profits were affected (or tainted) by the fraud.

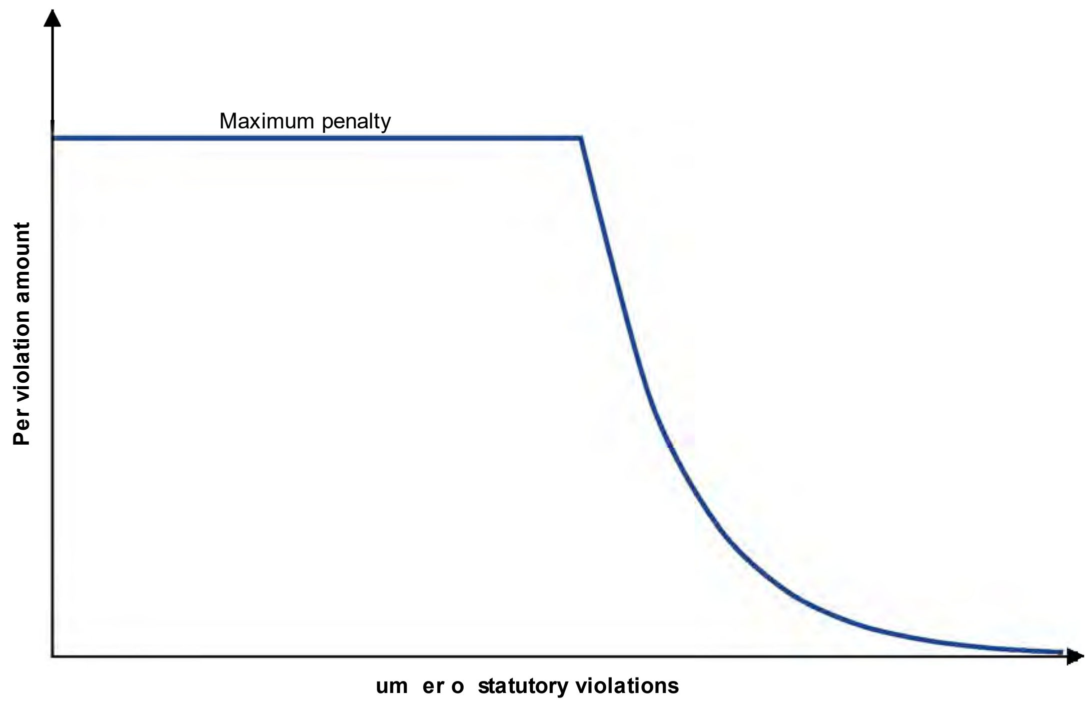
(33) As discussed above, in the Plaintiff States' statutes at issue, penalties are assessed on a per-violation basis. In the figures below, I summarize the implications of the economic literature reviewed above for the relationship between the number of violations and the optimal level of penalties. The specific numbers I use are purely for illustrative purposes. First, consider the total penalty required for deterrence; see Figure 1 below. Because both the harm and gain increase with the number of violations, so should the required total penalty necessary for deterrence. However, at some point, the level of the penalty is sufficiently high such that optimal deterrence has been achieved or the risk of overdeterrence exceeds the benefit of higher penalties. At that point, the total penalty amount no longer increases with the number of violations, and the curve flattens. As discussed further below, in this instance, it is my opinion that whether the relevant number of statutory violations is the number calculated by Dr. Wiggins (579 billion) or Mr. Andrien (29 trillion), Google should be considered to be in the flat portion of the aggregate penalty curve. In other words, given the exceptionally large number of potential violations in this case, even if one were to use Dr. Wiggins's number, if the jury were to find that the conduct violates the relevant statutes, the appropriate deterrent amount should be determined not based on the precise number of statutory violations, but rather based on broader considerations of the total amount necessary to deter the conduct in the future.

Figure 1: Total deterrent penalty amount with per-violation penalties



(34) Figure 2 depicts the implications for the optimal penalty per violation. Initially, for a small number of violations, the per-violation penalty is the optimal penalty based on the economic considerations discussed above. In general, as the total penalty increases with the number of violations, the per-violation penalty can increase or decrease. For example, if the gains or harm increase proportionately with the number of violations (or the optimal level is already constrained by the maximum statutory penalty per violation), the penalty per violation is constant, as illustrated in Figure 2. Then, at some point, the maximum total penalty is achieved, at which point the total penalty no longer increases, and so the optimal per-violation penalty decreases with each additional violation. These graphs highlight why, given the large number of potential violations in this case, it is important to begin a deterrence analysis by first determining an aggregate deterrence penalty amount, and then converting that into a corresponding per penalty violation, rather than the reverse: if instead, one were to begin the analysis by attempting to develop a per violation amount, the result could be an aggregate penalty that either is insufficient for deterrence or results in overdeterrence. Thus, the appropriate per violation deterrent penalty will necessarily be small; not because it indicates that the harms or benefits from the conduct were very small, but because whether the conduct is deterred depends on the aggregate penalty amount to be assessed (the numerator), and because the number of violations (the denominator), by any measure, is exceptionally large.

Figure 2: Penalty per violation



II.C. The implications of the "principal-agent" problem for deterrent penalties

(35) In determining an appropriate deterrent penalty amount for a public company, such as Alphabet, where the costs of the penalty are ultimately borne by shareholders but the conduct is attributable to actions or decisions by company management, it is also important to consider the "principal-agent" problems that arise with such companies. The problem of agency between a principal and an agent, and the need to account for the potentially differing incentives between a principal and their agent, has been extensively studied in the academic literature. In many economic transactions, one party (the agent) takes actions that affect the welfare of the other party (the principal), but the agent's actions are not completely controllable by the principal, and the agent's interests may diverge from those of the principal.[48] A classic example of a principal-agent problem is in the context of a bank: a bank manager – acting as the agent of the banks' owners, who are the "principals" in a banking enterprise – may have a financial incentive to be insufficiently attentive to the credit risks on the loans that they make if their compensation is tied to the volume of loans they originate; and if a

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[48] *See*, e.g., Bengt Holmstrom, "Moral Hazard and Observability," *Bell Journal of Economics* 10, no. 1 (Spring 1979): 74–91.

default on the loans is likely to occur after the end of their employment (or if a future loan default does not enable a bank to claw back a manager's prior compensation). In that scenario, the costs of a loan default are borne entirely by the principals. This "principal-agent" problem is not just an academic construct: extensive loan defaults and bank trading desk losses during the 2008 – 2009 financial crisis have been attributed, at least in part, to this misalignment of incentives.[49]

(36) The principal-agent problem is a general problem applicable to publicly-traded firms such as Alphabet. Public ownership allows for the separation of ownership and effective control, i.e., it allows equity investors (i.e., shareholders or owners) to be distinct from managers who make day-to-day decisions. Under this structure, managers (the agents) may behave in ways that benefit them at the expense of the shareholders (the principals). In the context of this case, the principal-agent problem may manifest itself if Alphabet's managers disregard or pay limited attention to the potential cost of their decisions on Alphabet's shareholders, e.g., by choosing to engage in deceptive trade practices, when the ultimate cost of such practices (if detected by enforcement agencies) is borne by Alphabet's shareholders, rather than by its managers.

(37) The economics and finance literature has proposed alternative solutions to the principal-agent problem. These include offering appropriate incentives for managers to make decisions in line with the shareholders' interests or closer monitoring of the firm's managers. If these are effective, the interests of shareholders and managers would be aligned such that managers would not engage in conduct that, if detected, would result in the imposition of penalties, hurting the shareholders. In reality, neither of these alternative solutions necessarily fully addresses the principal-agent problem.[50]

(38) *Incentives may be ineffective:* Because the source of the principal-agent problem in publicly traded firms is the disconnect between ownership and effective control, an obvious solution is to effectively compensate the managers in part with stock (or stock options) so as to align incentives. In line with this approach, firms such as Alphabet provide stock-based compensation (i.e., stock grants and stock options) to its employees.[51] Stock-based compensation for management, however, will still not fully align management's incentives with the outside shareholders, for two reasons. First, management compensation is seldom based *entirely* on stocks; as such, there remains some degree of principal-

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[49] *See*, e.g., Sunit Shah, "The Principal Agent Problem in Finance," March 1, 2014, *CFA Institute Research Foundation* L2014-1, available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2574742.

[50] Richard Brealey, Stewart Myers, and Franklin Allen, *Principles of Corporate Finance*, (McGraw Hill, Eighth Edition), Chapter 12, pp. 303–309.

[51] In 2023, Alphabet recorded a stock-based compensation expense of $22.46 billion. *See* Alphabet Inc., *Form 10-K 2023*, January 30, 2024, 55.

agent problem.[52] Second, and most importantly, it is management's current performance that results in the award of stock-based compensation (in addition to cash bonuses and increases in salaries).[53] As such, the value of the stock awards (as well as cash bonuses or salary increases) that management receives from engaging in misconduct that increases the company's current profits (and the current stock price) are likely to exceed the financial impact to management of a future penalty imposed on the company as a result of their conduct, which is likely borne by all shareholders.

(39) For example, assume that a Google Product Manager were able to increase the company's profits by $100 million in a given year as a result of deceptive conduct, and for which the manager receives $1 million worth of stock-based compensation. Assume further that several years later, a $20 billion penalty is assessed against the company, when its pre-penalty valuation is $2 trillion; and that the $20 billion penalty is sufficiently large to cause a commensurate decline in the stock market capitalization of $20 billion, or 1% of the value of the stock. In that scenario, the value of the manager's stock award also falls by 1%, from $1 million to $990,000. While the manager would certainly prefer the $1 million value to the $990,000 value of their stock award, they are still far better off – by $990,000 – having engaged in the deceptive conduct than not. This simply reflects the fact that the costs to shareholders of the manager's conduct will not be fully internalized by the manager, even when the manager receives stock-based compensation. In fact, this will always be so, as long as the manager receives any amount of compensation for their current performance that is tied to the current profitability of the firm, whether that compensation is in the form of cash or stock. Thus, the principal-agent problem persists even with performance-based stock compensation.

(40) *Monitoring may be ineffective:* It is costly for a shareholder to monitor managers. Importantly, while the costs are borne entirely by the monitoring shareholder, all shareholders enjoy the benefits of having disciplined managers. So, each shareholder has an incentive to "free-ride" on someone else's effort, leading to insufficient monitoring by shareholders. This is particularly challenging when there are a large number of dispersed shareholders, each with a small share of the potential benefits. While a board of directors, which is supposed to represent the shareholders' interest, could ameliorate the free-rider problem, studies have identified situations or reasons why they are

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[52] Brian Hall and Kevin Murphy, "The Trouble with Stock Options," *Journal of Economic Perspectives* 17, no. 3 (Summer 2003): 49–70 [hereinafter, "Hall and Murphy (2003)"]; Alphabet's top management receive a base salary and are not wholly compensated using stock-based compensation. For example, CEO Sundar Pichai received a base salary of $2 million in 2023. *See* Alphabet Inc., *Form DEF 14A*, April 26, 2024, 53.

[53] For instance, employees may be granted stock options for which they receive stock when they exercise the option. An improvement in stock price offers employees a greater incentive to exercise the option. *See* Hall and Murphy (2003), pp. 50–51.

insufficiently effective.[54] Overall, the board is more likely to act when managerial decision-making has a sufficient impact on shareholders.[55]

(41) Besides the board, the free rider problem may be attenuated if there are shareholders with concentrated or large ownership. With more at stake, such shareholders have a greater incentive to play an active role in firm monitoring (i.e., to be "activist" investors). In many cases, these tend to be large institutional investors, such as mutual funds and hedge funds, rather than retail investors. Over 60% of Alphabet stock is owned by institutions.[56] However, much like the board, institutional investors suffer from their own agency problems and do not provide a complete solution to the problem. They, too, are more likely to act when the upside of their activism outweighs the costs of those actions.[57]

(42) In summary, the principal-agent problem is endemic to a publicly-traded firm like Alphabet. When management engages in potentially actionable conduct, like deception, it exposes the shareholders to the risk of a penalty for the firm's misconduct. As Dr. Skinner acknowledges, penalties could impose costs on the shareholders.[58] Even if the shareholders – including large individual or institutional investors with a substantial stake in Alphabet – recognize this expected loss, they may not have an incentive to preempt or deter such misconduct unless the expected impact of the penalty is sufficiently large. Certain actionable managerial conduct may also benefit shareholders, e.g., as with such conduct that allows the firm to earn higher long-term profits. All else equal, the fact that there are likely shared benefits – at least over the short-term, and if undetected, even over the long-term – would further disincentivize shareholders from monitoring management's conduct.

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54 *See* Eliezer Fich and Anil Shivdasani, "Are Busy Boards Effective Monitors?" *Journal of Finance* 61, no. 2 (2006): 689–724 (they find that firms with more "busy" directors have lower market-to-book ratios than other firms). *See also*, Ivan Brick, Oded Palmon, and John Wald, "CEO Compensation, Director Compensation, and Firm Performance: Evidence of Cronyism?" *Journal of Corporate Finance* 12, no. 3 (2006): 403–23 (they suggest the possibility of cronyism between the directors and the CEO).

55 Richard Brealey, Stewart Myres, and Franklin Allen, *Principles of Corporate Finance*, (McGraw Hill, Eighth Edition), Chapter 2, p. 25 ("Boards of directors are sometimes portrayed as passive stooges who always champion the incumbent management. But when company performance starts to slide and managers do not offer a credible recovery plan, boards do act").

56 Defined as positions from SEC form 13F filings plus data aggregated from the mutual funds of non-13F filers. Source: S&P Capital IQ, Alphabet Inc. Public Ownership Summary, accessed August 29, 2024; SEC Form 13F is the reporting form filed by institutional investment managers and must be filed by managers that operate in the U.S. and exercise investment discretion over $100 million or more in securities. *See* SEC, "Frequently Asked Questions About Form 13F," May 25, 2023, https://www.sec.gov/divisions/investment/13ffaq, accessed August 29, 2024.

57 Lucian Bebchuk, Alma Cohen, and Scott Hirst, "The Agency Problems of Institutional Investors," *Journal of Economic Perspectives* 31, no. 3 (Summer 2017): 89–102.

58 Skinner Report, ¶ 15 ("certain adverse consequences the proposed penalty could have on Alphabet's shareholders, business, competitive position, and ability to innovate").

In such a case, for a penalty to be an effective deterrent, the expected impact of the penalty would have to be even larger for shareholders to undertake effective remedial steps at the firm.

(43) The above review is helpful for determining the amount of a penalty that would be necessary to incentivize shareholders to monitor management and deter future misconduct, if actionable conduct is detected and found to be a violation of the relevant statutes. In a public company like Alphabet, the stock price serves as a market barometer of shareholder value. A large price reaction has a correspondingly large impact on a shareholder, providing a larger incentive to monitor and deter misconduct. Unless a penalty amount is large enough to have a sufficiently large impact on the stock price, thus spurring the shareholders to monitor management, it would be ineffective for purposes of subsequent deterrence.

III. Scope of the alleged conduct and associated harm

(44) Dr. Wiggins narrowly focuses his analysis of the scope of the alleged conduct on a single Google product, AdX, and on "the number of transactions allegedly 'affected' by Google's misconduct."[59] Dr. Skinner focuses on only three of Google's six DVAA, i.e., Ad Tech products.[60] Given the structure and economics of the Ad Tech industry, however, and the breadth of the conduct at issue in the Plaintiff States' claims, Dr. Wiggins's and Dr. Skinner's analyses focus on an overly narrow set of products and transactions. In this section, I first summarize my understanding of the relevant Ad Tech industry and its main components. I then discuss what the economics of the market implies about the likely scope of the impact of the conduct at issue, in terms of both the specific products likely impacted by the conduct and the types of likely benefits (to Google) and harm to others, including publishers, advertisers, competitors, and ultimately consumers.

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[59] Wiggins Report, ¶ 118; *see* Wiggins Report, §§ III.B and III.C for a high-level discussion of his approach Wiggins Report, § IV for details of his calculations.

[60] Skinner Report, ¶ 22 ("I understand that Plaintiffs' remaining claims in this matter focus on certain DVAA products; specifically, Google Ad Manager (including certain functions that had been performed by AdX and DFP), Google Ads, and DV360. I further understand that certain of the revenues and profits attributable to these products relate to transactions involving in-app ads, which I understand Plaintiffs do not consider to occur in the relevant markets.") I note that Dr. Skinner provides no evidence to support his decision and fails to cite to Plaintiff reports for his understanding. Instead, he cites to a 50-page section in the Fourth Amended Complaint (§ VI and pages 30–34 therein) without explaining how that section informs his understanding or how he reconciles his understanding with the analyses put forward by Plaintiff experts; *see* Skinner Report, footnotes 23 and 24.

III.A. Scope of **Google's** Ad Tech products and market participants potentially affected by conduct at issue

(45) The online display advertising industry includes three types of participants and technologies: (i.) publishers and ad servers; (ii.) advertisers and ad buying tools; and (iii.) ad exchanges.[61] Publishers are sellers of ad inventory on their webpages, a process facilitated by ad servers in either live ad auctions or direct deals.[62] Advertisers are buyers of ad inventory, a process facilitated by ad buying tools.[63] Ad exchanges and ad networks match advertisers (buyers) to publishers (sellers) and run the auctions to determine which advertiser wins the impression on a publisher's webpage or app.[64]

(46) Figure 3, below, taken from an internal Google presentation from January 2020, provides a visualization of how Google's Ad Tech products are connected. Note that Google's products interact with competitors' demand-side platforms ("DSPs") and supply-side platforms ("SSPs," non-Google exchanges). These products also feed into other forms of digital advertising and Google products, including YouTube, Google Play, Gmail, as well as Google Search (through Google Ads/AdWords).[65]

(47) On the advertiser (marketer/buyer) side, Google offers the following demand-side ad buying tools:[66]

- DV360 and CM 360 (formerly known as DCM) generally serve larger, more sophisticated advertisers.

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61 *See* Expert Report of John Chandler, June 7, 2024 [hereinafter "Chandler Report"], § VII, for an overview of the ad tech industry.

62 *See,* e.g., Chandler Report, § VII.C, and Expert report of Matthew Weinberg, June 7, 2024 [hereinafter "Weinberg Report"], § III.A.1.

"There are two key ways through which an ad server might sell inventory. In a live ad auction, the ad server learns that a particular user is visiting the publisher's webpage, and while the page loads, runs an auction for the right to display an ad to this particular user. The auction begins only after the user is known, so potential advertisers can submit a bid based on the finegrained information they learn about the user. In a direct deal, the publisher pre-arranges a contract with an advertiser to display their ad some number of times across some period at some predetermined price per impression, perhaps to users that satisfy some coarse targeting criteria. The ad server manages that deal as users visit the publisher's webpage. Because of this, while targeting criteria can still be used, it is coarser in comparison to the real-time data available in a live ad auction." (Weinberg Report, ¶ 69)

One way ad servers sell an impression is through a process called a "waterfall," whereby they sequentially check for a match with a potential demand source (a line item) and typically prioritize direct deals ahead of ad exchanges. Alternatively, header bidding solicits bids from multiple exchanges simultaneously, thereby addressing the inefficiencies of sequentially bidding. *See*, e.g., Weinberg Report, § III.B, for details.

63 *See,* e.g*.,* Chandler Report, § VII.D, and Weinberg Report, § III.A.2.

64 *See,* e.g*.,* Chandler Report, § VII.E, and Weinberg Report, § III.A.3.

65 *See* Chandler Report, § V for a discussion of different digital marketing channels, and § VIII for a detailed discussion of Google's ad tech products.

66 *See also* Chandler Report, § VII.D. and "Introducing Campaign Manager 360," *Campaign Manager 360 Help*, accessed August 21, 2024, https://support.google.com/campaignmanager/answer/10157783?hl=en

- Google Ads (formerly known as AdWords) generally serves small, less sophisticated advertisers. However, Google Ads also provides access to Google's search product by allowing targeting based on previous keyword searches.[67] "Advertisers who are managing their own search campaigns need to use Google Ads. And, while search is a distinct channel, once an advertiser is using Google Ads for search, the barrier is low to use it for parts of their display advertising."[68]

(48) On the publisher (seller) side, Google's supply-side offers AdSense, AdMob, and DoubleClick for Publishers (DFP), which has been integrated into Google Ad Manager (GAM).[69] AdMob is designed specifically for mobile app developers and publishers;[70] AdSense is focused on websites;[71] and GAM is focused on large publishers and (for web and app) supports multiple ad networks and exchanges (including those of Google and third parties).[72]

(49) Buyers and sellers are matched through Google's ad exchange called AdX and Google's ad network called Google Display Network (GDN).[73] AdX has been combined with DFP into GAM.[74] GDN includes an advertiser-facing component (Google Ads/AdWords) and a publisher-facing component (AdSense and AdMob) and acts as an intermediary between advertisers and sellers.[75]

67 Chandler Report, ¶ 182.

68 Chandler Report, ¶ 182.

69 "Compare Ad Manager, AdSense, and AdMob," *Google Ad Manager Help*, accessed August 21, 2024, https://support.google.com/admanager/answer/9234653?hl=en.

70 "AdMob vs. Google Ad Manager. Which One Is Better*?" Ad.Plus*, accessed August 30, 2024, https://blog.ad.plus/google-ad-manager-vs-admob/.

71 "Compare Ad Manager, AdSense, and AdMob," *Google Ad Manager Help*, accessed August 21, 2024, https://support.google.com/admanager/answer/9234653?hl=en.

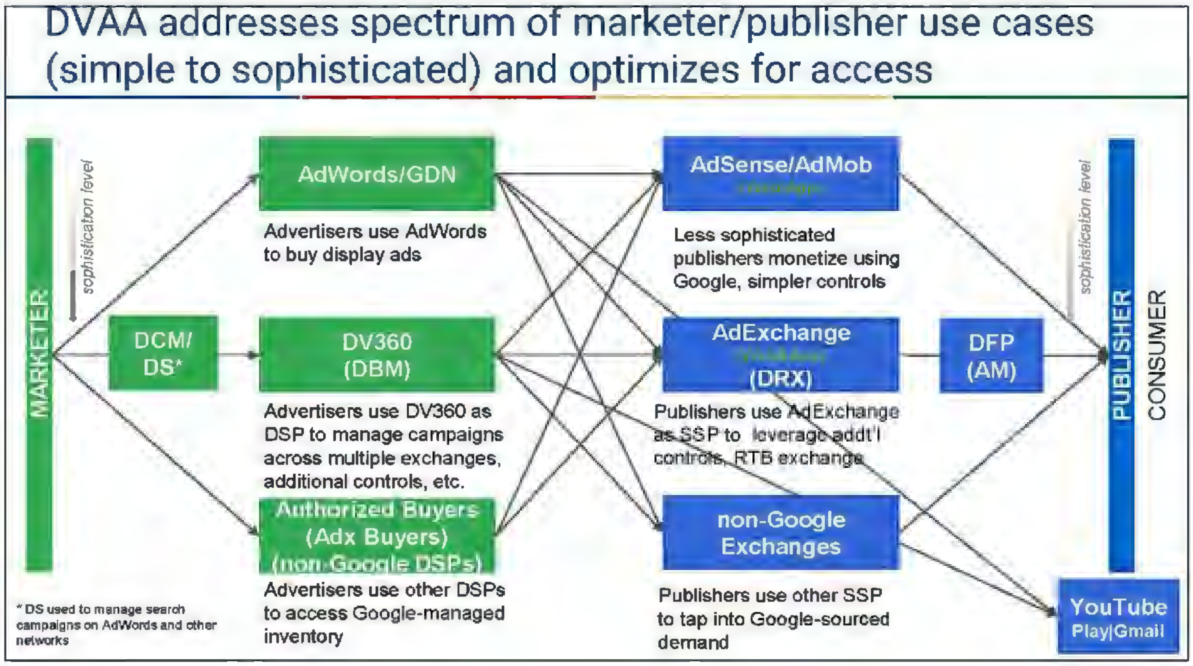
72 "Advertising with Google Ad Manager," *Google Ad Manager Help*, accessed August 30, 2024, https://support.google.com/admanager/answer/6022000?hl=en.

73 "There are two main differences between ad networks and ad exchanges. The first is that ad networks are regarded as brokers for ads, while ad exchanges are open marketplaces, much like a stock exchange. The second difference is that ad exchanges are almost fully automated systems." (Chandler Report, ¶ 185).

74 Jonathan Bellack, "Introducing Google Ad Manager," *Google Ad Manager*, June 27, 2018, https://blog.google/products/admanager/introducing-google-ad-manager/.

75 GOOG-DOJ-AT-00221276 at -1310 and -1311 (2018 internal Google Display Network overview).

Figure 3: Google DVAA products and their interactions



Source: GOOG-NE-09556461 at -6463.
Notes: The names of several Google products have changed since this figure was made in 2020. For example, DCM is now CM360, AdWords is now Google Ads, and AdExchange and DFP are together now Google Ad Manager (GAM).

(50) See Appendix D for additional depictions of Google's Ad Tech products and those of its competitors.

III.B. The two sides of the Ad Tech industry (publishers and advertisers) are interdependent

(51) Parts of the Ad Tech industry, as discussed above, have features with characteristics of what the economics literature refers to as two-sided markets,[76] including the presence of indirect network effects.[77] Two-sided markets have two distinct sets of participants, e.g., publishers and advertisers, who interact through an intermediary (commonly called a platform), e.g., an ad exchange or network.[78] When the value of the platform to one set of participants, e.g., advertisers, depends on

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[76] Note that I am using the term "two-sided markets" as it is used generally in the academic economics literature. I am not opining on the appropriate definitions of relevant antitrust markets for the Ad Tech industry.

[77] For a recent survey of the economic literature on two-sided markets, see Jullien, B., Pavan, A., and Rysman, M. (2021). Two-sided markets, pricing, and network effects. In Ho, K., Hortaçsu, A., and Lizzeri, A., editors, *Handbook of Industrial Organization*, volume 4, chapter 7, pages 485–592. *Elsevier*.

[78] I understand that Dr. Joshua Gans has evaluated and defined four relevant product markets, only one of which (the

the behavior of the other set of participants, e.g., publishers, there are feedback loops between the two sides of the platform, which are called indirect network effects.[79]

(52) Scale (or aggregation) plays an important role in two-sided markets. Dr. Chandler, in his analysis of Ad Tech industry, points to the role of scale in facilitating transactions and enhancing the value of the platform:

> "On the supply side, there are publishers, like websites with space where ads can be displayed. On the demand side, there are advertisers who seek to display their ads to a specific audience. In order to scale up and facilitate the transactions between the two sides, a broader set of entities have emerged, which includes supply side platforms (SSPs) which help aggregate advertising inventory, demand side platforms (DSPs) which help aggregate and place advertising inventory, and exchanges which facilitate the exchange between the two sides."[80]

(53) Similarly, Dr. Weinberg explains the importance of scale for the value that an exchange brings to both sides of the platform:

> "Publishers (via ad servers) and advertisers (via ad buying tools) form the sell side and buy side of the markets for live ad auctions. It is not a trivial process for ad servers and ad buying tools to find each other and transact. Even for something that is commonly bought and sold, such as a designer coat, finding every interested buyer on the internet is a difficult task. As a buyer, it is also a difficult task to scour the internet to find all the designer coats you are interested in. Hence a third-party market/exchange/bazaar would be relied on to aggregate supply and demand. For example, customers go to platforms like eBay for Pokémon cards, Etsy for engraved chopsticks, and Amazon for books. In all of these cases, the customers rely on the

market for ad exchanges for transacting indirect open web display advertising) has two distinct sets of customers and could arguably be considered a multisided transaction platform. Other distinct products or tools, such as publisher ad servers and ad buying tools for small and large advertisers, are not multisided. *See also* Gans Report, § I.D.

[79] "A central aspect of platform economics is the role of network effects, which apply when a product is valued based on the extent to which other market participants adopt or use the same product. Of particular interest are indirect network effects, which emerge when the adoption and use of a product leads to increased provision of complementary products and services, with the value of adopting the original product increasing with the provision of such complementary goods. For instance, as more consumers adopt a video game console such as the Sony Playstation, more game-developers invest in developing games for that platform, raising the value of the console to consumers. In this sense, indirect network effects lead the platform firm to take into account the various interdependencies between the two sides of the market, and the pertinent literature studying such interdependencies is often termed the study of two-sided markets." (Jullien, B., Pavan, A., and Rysman, M. (2021). Two-sided markets, pricing, and network effects. In Ho, K., Hortaçsu, A., and Lizzeri, A., editors, *Handbook of Industrial Organization*, volume 4, chapter 7, pages 485–592. *Elsevier*, p. 488).

[80] Chandler Report, ¶ 143.

> platform primarily to match them to sellers. The market for impressions is no different, and ad exchanges exist to help publishers meet advertisers."[81]

(54) Another characteristic of two-sided markets is that such "[p]latforms set prices on each side of the market accounting for the complex interactions between the various platform's users."[82] Indeed, Rochet and Tirole highlight the interdependencies in the fees (prices) and volume of transactions on both sides of the platform in their definition of two-sided markets:

> "We define a two-sided market as one in which the volume of transactions between end-users depends on the structure and not only on the overall level of the fees charged by the platform. A platform's usage or variable charges impact the two sides' willingness to trade once on the platform and, thereby, their net surpluses from potential interactions; the platforms' membership or fixed charges in turn condition the end-users' presence on the platform. The platforms' fine design of the structure of variable and fixed charges is relevant only if the two sides do not negotiate away the corresponding usage and membership externalities."[83]

III.C. **Google's** conduct likely had broad impacts on market participants due to complex interdependencies among Ad Tech products

(55) Interdependencies between the buyer and the seller sides of the Ad Tech industry imply that all of Google's DVAA products are interconnected. Therefore, Dr. Wiggins and Dr. Skinner err when focusing narrowly on a subset of Google's DVAA products. In contrast, the reports of Dr. Weinberg and Dr. Chandler analyze and recognize these interdependencies and account for them in drawing conclusions about the scope of the conduct. Mr. Andrien similarly recognizes these interdependencies when reaching his conclusions.[84] As I explain in this section, the conduct at issue

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81 Weinberg Report, ¶ 76.

82 Jullien, B., Pavan, A., and Rysman, M. (2021). Two-sided markets, pricing, and network effects. In Ho, K., Hortaçsu, A., and Lizzeri, A., editors, *Handbook of Industrial Organization*, volume 4, chapter 7, pages 485–592, *Elsevier*, p. 85.

83 Rochet, J.-C. and J. Tirole (2006). Two-sided markets: A progress report. *RAND Journal of Economics* 37, p. 646.

84 Andrien Report, § IV.F.1, *e.g.,* "Thus Google's deceptive misconduct affecting DFP publishers on AdX is enhanced because of publisher difficulty in leaving the platform – they cannot easily switch to a non-deceptive competitor. As I explain above, due to indirect network effects, increased AdX win rates and revenue from the deceptive misconduct results in attracting more publishers and advertisers to Google's platform, furthering Google's monopoly position. Hence, each type of alleged conduct reinforces the other. The deceptive misconduct alleged in this matter is thus properly viewed as part of an overall scheme by Google to dominate and maintain its place in the display advertising industry using various levers at its disposal, including the misconduct at issue. Google gained both direct and indirect benefits as a result of its misconduct." (Andrien Report, ¶¶ 114 and 115).

is central to Google's Ad Tech business and, as I explain in the next section, more broadly impacts Google's other lines of business.

(56) Dr. Weinberg's opening report analyzes Google's conduct at issue, how this conduct changed the auction procedures, and how these changes affected auction outcomes.[85] He concludes that Google's conduct impacted both AdX and GDN, i.e., both ad exchanges and ad networks, and consequently revenues for the advertiser (buyer) and publisher (seller) sides of the Ad Tech market, and revenues and win rates for rival exchanges and ad buying tools.[86] Moreover, as Dr. Weinberg emphasizes, Google's deceptive conduct spanned multiple years and many different instances of deceptive conduct,[87] as well as updated and optimized versions of that conduct, e.g., DRS v1, DRSv2, "truthful" DRS (tDRS), and the associated "dirty second-price auctions."[88] In his reply report, Dr. Weinberg explains how his analysis shows that "Google's entire ecosystem is deceptive,"[89] and every auction is affected by Google's deceptive conduct.[90] As a result, the benefits to Google and the harm to others are likely greater than if the conduct were isolated, and the products were independent without any market or technological interconnections.

(57) Dr. Chandler similarly concludes that Google's conduct affected all participants, and hence all products and transactions, in the Ad Tech industry that use or interact with Google's products:

> "Google's Bernanke, Global Bernanke, Bell, Reserve Price Optimization (RPO), Dynamic Revenue Sharing (DRS), Poirot, Elmo, Exchange Bidding, Dynamic Allocation (DA), Enhanced Dynamic Allocation (EDA), tying DFP to AdX, and Privacy Sandbox programs and practices entailed one or more of the following: (a) failures to adequately or timely disclose changes to the auction's mechanics and purposes; (b) unwarranted restrictions on material information needed by auction participants and intermediaries; (c) denials of equal and fair access to inventory, demand, and functionality to advertisers, publishers, ad servers, exchanges, or ad buying tools; and (d) conflicts of interest. Those programs and practices jeopardized, and

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85 Weinberg Report, ¶ 11. Specifically, Dr. Weinberg's opening report main focus is on Google's conduct as regards to: Dynamic Allocation, Dynamic Revenue Sharing, Exchange bidding, Project Bernanke, Unified Pricing Rules and Reserve Price Optimization.

86 Weinberg Report, ¶ 12.

87 Expert Rebuttal Report of Matthew Weinberg, September 9, 2024 [hereinafter "Weinberg Rebuttal Report"], § IV.B.

88 Weinberg Report, § VII.

89 Weinberg Rebuttal Report, fn. 35 and § IV.

90 Weinberg Rebuttal Report, § IV.G.

detrimentally affected, transparency and fairness of the auctions in which they were employed."[91]

(58) In addition, Dr. Chandler concludes that Google's conduct impacted the structure of the Ad Tech markets and enhanced Google's dominance in these markets:

> "When faced with competitive threats, Google has strategically acquired competitors to maintain and enhance its market position. This approach has enabled Google to eliminate potential rivals and integrate valuable technologies, reinforcing its dominance in the ad tech ecosystem. Through these acquisitions, Google has built its dominant position in the display advertising market."[92]

(59) Google's scale advantage has been commented on by rivals. [redacted][93] For example, header bidding has significant benefits for market participants,[94] with the potential to increase competition in the industry.[95] To the extent that Google's deceptive conduct (including AdX's "last look" advantage) has undermined the benefits of header bidding,[96] it has had long-lasting impacts by reducing competition in the Ad Tech industry.

(60) Based on my understanding of the industry and products at issue, as well as my review of the expert reports analyzing the conduct in more detail, I expect that Google's conduct at issue would have had the following types of effects: (i.) an increase in effective prices paid by advertisers;[97] (ii.) a decrease in revenues earned by publishers;[98] (iii.) a decrease in revenues and profits earned by Google's Ad

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91 Chandler Report, ¶ 23, bullet 17.

92 Chandler Report, ¶ 23, bullet 7 and § VIII.

93 [redacted].

94 Weinberg report, ¶¶ 150 ("In my opinion, header bidding improves publisher revenue and fill rate210 in comparison to the waterfall process. Furthermore, header bidding's auction mechanics generate higher revenue for publishers than Exchange Bidding's auction mechanics do.") and 156 ("The auction mechanics of header bidding (without Enhanced Dynamic Allocation) would generate increased revenue for publishers, as compared to all exchanges participating in Exchange Bidding."), and Weinberg Rebuttal Report, § XIII.

95 [redacted]

96 *See* Weinberg Report, § III.B.2, for an explanation of header bidding, Weinberg Report, § V.C, for a discussion of AdX's "last look" advantage, and the Weinberg Report generally for a discussion of how header bidding and Google's conduct interacted. *See* Andrien Report, § III.D.v, for a discussion of the Google/Facebook Network Bidding Agreement ("NBA") and header bidding.

97 *See, e.g.,* Weinberg Report, ¶¶ 12.a, 12.d, and 12.f.

98 *See, e.g.,* Weinberg Report, ¶¶ 12.a, 12.c, 12.d, and 12.f.

Tech product competitors;[99] (iv.) a reduction in the financial incentives or ability for Google's Ad Tech product competitors to remain in the markets, resulting in exit by competitors and increased market dominance by Google; (v.) support for the ability of Google to maintain its win rates and revenue above a competitive level without the deceptive conduct;[100] and (vi.) the loss of faith and confidence of advertisers, publishers, and other actual or potential competitors to Google in the transparent functioning of ad auctions and the Ad Tech product markets more generally.[101] The structure of the industry, and particularly Google's large share in many of the relevant products during the conduct period,[102] likely significantly increased the severity of the effects of Google's conduct at issue. As a market participant such as Google increases its market shares, and as other industry participants come to rely increasingly on these types of products to participate in the "marketplaces" for these goods and services (i.e., as online publishers and online advertisers increasingly become dependent on Ad Tech technologies and exchanges to purchase and sell "programmatic" advertising space), it becomes harder or commercially impracticable for industry participants to avoid the effect of Google's conduct, as would be the case if they were able to rely on alternative, competing non-Google advertising "ecosystems."

(61) As Dr. Chandler notes, see above, the scope of the effects of Google's conduct likely extended beyond the participants in the Ad Tech industry, i.e., publishers, advertisers, and exchanges. Higher advertising prices (for advertisers) or lower revenues (for publishers and Google's Ad Tech competitors) are equivalent to an increased cost or an additional tax on these market participants. A large economic literature finds evidence that firms pass-through higher costs or taxes to consumers, particularly when, as is the case here, the higher costs or taxes are likely incurred by all market participants.[103] Thus, the harm from Google's alleged conduct was likely not restricted to the participants in the Ad Tech industry, but likely extended all the way to final consumers in the form of increased costs for the products sold by both advertisers and publishers (e.g., higher newspaper subscription costs to make up for lower advertising revenues). Reduced competition resulting from Google's alleged conduct may also have adverse implications for the quality of service in the Ad Tech

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99 *See, e.g.,* Weinberg Report, ¶¶ 12.a, 12.c, 12.d, 12.e, and 12.f.

100 *See, e.g.,* Weinberg Report, ¶¶ 12.a, 12.c, 12.d, 12.e, and 12.f.

101 *See, e.g.,* Weinberg Rebuttal Report, §§ IV.B and IV.G.

102 I understand Dr. Gans concludes that "Google had and continues to have a substantial degree of monopoly power in each of these markets at various times, facilitated by entry barriers and switching costs between providers of ad tech tools." (Expert report of Joshua Gans, June 7, 2024, ¶ 14.b.)

103 *See,* e.g., James Alm, Edward Sennoga, and Mark Skidmore, "Perfect Competition, Spatial Competition, and Tax Incidence in the Retail Gasoline Market" (Fiscal Research Center, Georgia State University, FRC Report No. 112, September 2005), p. vi ("there is a one-to-one increase in the tax-inclusive gasoline price from an increase in the gasoline tax"). *See also* Daniel Aaronson, "Price Pass-through and the Minimum Wage," *The Review of Economics and Statistics* 83. no. 1 (February 2001): 158-169 ("restaurant prices generally rise with changes in the wage bill").

industry.[104] Lower publisher revenue may also have adverse implications for the quality of publishers' products, e.g., less available revenue dedicated to creating high-quality content, or a greater amount of space allocated to online or in-app advertising to make up for the lower revenue that they otherwise earn from online advertising, in part due to Google's high take-rate of advertising revenue.

III.D. **Google's** conduct likely had impacts beyond **Google's** third-party Ad Tech business

(62) Dr. Wiggins and Dr. Skinner claim, as I explain above, the impact of Google's deceptive conduct was limited to only a small subset of AdX transactions and DVAA products. My understanding of the industry and the conduct at issue suggests that their claim is incorrect and the conduct likely had impacts beyond Google's Ad Tech business. Specifically, there are several ways in which Google's scale in advertising provided it with leverage across its different business lines, including: (i.) shared data about users collected across its products; (ii.) demand-side linkages between products; and (iii.) the impact of Google's conduct at issue on AdWords. In addition, because Google is vertically integrated—it both produces Ad Tech services that it sells to others, and it also consumes them as a publisher in its own right—its advertising business on its own properties, e.g., YouTube, Gmail, and Google Play, was likely impacted by the conduct.

(63) First, as Dr. Chandler explains, display advertising is one of many digital marketing channels, including search, social media, digital video, and in-app advertising.[105] Dr. Chandler concludes that success in these is interrelated because of Google's ability to collect data "across multiple touchpoints":

> "Google's scale advantage in the digital advertising ecosystem is formidable, primarily due to its vast reach and extensive first-party data. Google's numerous services, including Google Search, YouTube, Google Maps, Gmail, and the Android operating system, allow it to collect a wealth of user data across multiple touchpoints. This data provides Google with unparalleled insights into user behavior, preferences, and interests, enabling highly accurate targeting and personalization of ads."[106]

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104 Myongjin Kim, Qihong Liu, and Nicholas G. Rupp, "When Do Firms Offer Higher Product Quality? Evidence from the Allocation of Inflight Amenities," *Review of Industrial Organization* 62 (2023):149-177. I understand Dr. Gans concludes that "Google has engaged in anticompetitive conduct that has enhanced and maintained its monopoly power in these relevant markets." (Gans Report, ¶ 14.c.)

105 Chandler Report, § V.

106 Chandler Report, ¶ 284.

(64) Second, Google's products are interrelated on the demand side as consumers choose between different marketing channels.[107] Consistent with Dr. Chandler's assessment, on its website, Google emphasizes the connections between its advertising related products: "Google Network, our name for the places where your ad can appear, including Google sites, web pages that partner with us, and other placements like mobile phone apps."[108] This "bundle of sites" is composed of Google's Search Network and its Display Network,[109] and Google emphasizes customers' ability to reallocate their advertising expenditures and programs between Google's offerings on the Google Network, including the ability of advertisers to switch between advertising on third-party publishers' properties and on Google's own properties:

> "If you see that you're not getting a good return on investment from an area of the network, you can exclude individual sites on the Display Network or change your ad campaign's network settings to opt in or out of each network."[110]

(65) Dr. Wiggins also discusses how advertisers may shift or reallocate spending among digital advertising channels and products.[111] [redacted]

(66) Third, it is my understanding that Google's conduct at issue affected AdWords;[114] which, if correct, means that the impact of the conduct would have likely also affected Google's advertising revenues and profits on Google Search, and other products that use AdWords.

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107 Chandler Report, § V.

108 "The Google Network," *Google Ads Help*, accessed September 4, 2024, https://support.google.com/google-ads/answer/1721923?sjid=5862812278570074634-NA.

109 The Search Network includes "Google Search, the Shopping tab, Google Maps, and Google Groups; Search sites that partner with Google." *See* "The Google Network," *Google Ads Help*, accessed September 4, 2024, https://support.google.com/google-ads/answer/1721923?sjid=5862812278570074634-NA.

The Display Network includes "Google sites (like YouTube, Blogger, and Gmail) and thousands of partnering websites across the Internet." *See* "The Google Network," *Google Ads Help*, accessed September 4, 2024, https://support.google.com/google-ads/answer/1721923?sjid=5862812278570074634-NA.

110 "Google Network*," Google Ads Help*, accessed September 5, 2024, https://support.google.com/google-ads/answer/1752334?hl=en.

111 Wiggins Report, § II.B.2.

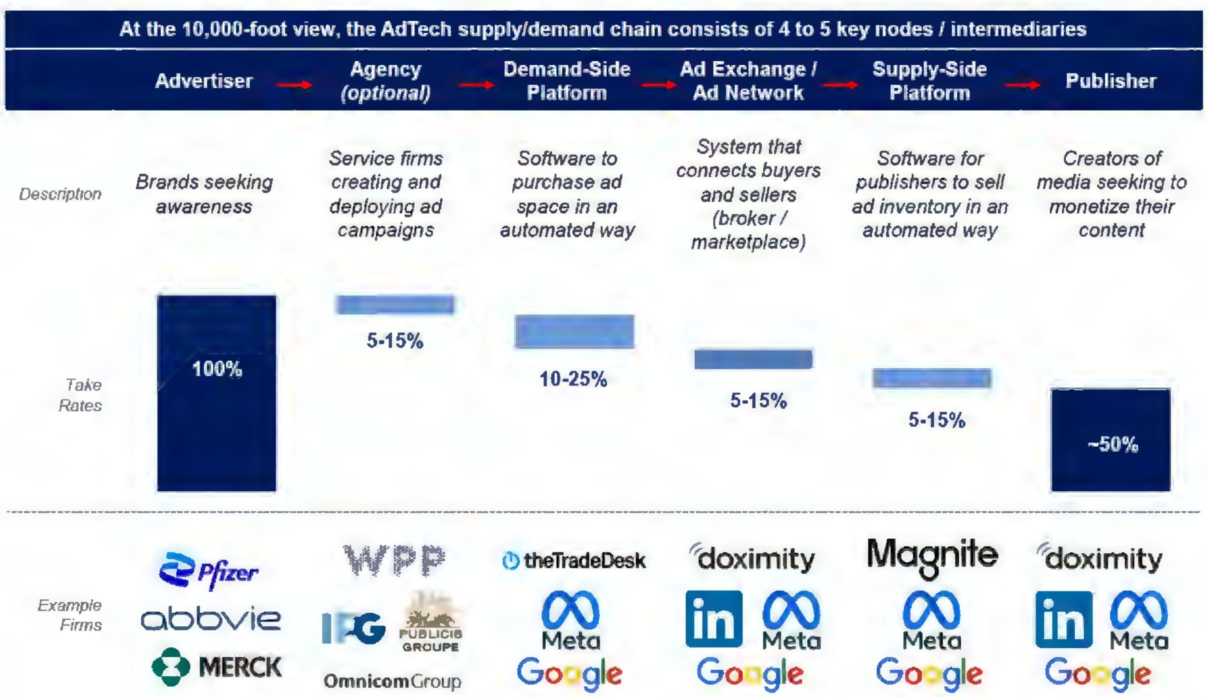
112 Wiggins Report, ¶ 51.

113 Wiggins Report, fn. 111.

114 *See* Weinberg Rebuttal Report, § IV.E.

(67) Fourth, Google is vertically integrated—it both produces Ad Tech services that it sells to others, and it also consumes them as a publisher of its own properties, e.g. YouTube, Gmail, and Google Play, in offering its own advertising space to advertisers, as shown in Figure 4, below. As discussed above, Google's conduct at issue in its Ad Tech products impacted both advertisers and publishers. To the extent that some of Google's conduct increased the prices paid by advertisers (while increasing the amount of Google's profits via its take rate), it likely also increased the prices it was able to charge advertisers on its own properties. If Google's deceptive conduct affected bidding behavior by both advertisers and publishers (e.g., for the latter, in terms of their price floors for particular types of impressions),[115] I would expect that conduct to also have affected advertisers' bidding on Google's own properties. Furthermore, since Google was able to use the conduct at issue to optimize its algorithms on AdX to maximize its own Ad Tech revenue by increasing prices paid by advertisers and maximizing its transaction volume,[116] that conduct likely provided Google with both data and experience with which to similarly increase the amount of revenue it earned from advertising on Google's own properties, either by increasing the prices it charged advertisers or by increasing its volume of advertising.

Figure 4: The Ad Tech supply chain



Source: Elizabeth Anderson, Patrick McNally, Sameer Patel, and Joanna Zhou, "Get with the Program(matic)!" Evercore ISI, Flash Note, Healthcare Technology & Distribution, August 24, 2023, p. 8.

[115] See the Weinberg Report for his detailed conclusions and Weinberg Report, § I.D for a summary.

[116] See the Weinberg Report for his detailed conclusions and Weinberg Report, § I.D for a summary.

Note: The figure is taken from an analyst report on Doximity, which provides services to the healthcare industry, and shows the Ad Tech supply chain and approximate take-rates at each step of the chain.

(68) The above suggests that Google's conduct at issue in Ad Tech may have provided it with broader benefits in Google's numerous other services, including YouTube, Gmail, and Search.

IV. Volume of commerce and profits of Google's businesses affected by the conduct at issue

(69) As discussed above, Dr. Wiggins and Dr. Skinner narrowly focus on a subset of the Google products in the Ad Tech market that were likely affected by the conduct at issue. Further, in assessing the appropriate penalty for the conduct at issue, Dr. Wiggins focuses his analysis solely on a narrow measure of commerce that does not measure the full extent of the conduct at issue. For example, Dr. Wiggins suggests in his lowest penalty estimate of $21.7 million that the only relevant revenues and profits are the incremental revenues and profits that Google was able to generate from the conduct at issue in the subset of Plaintiff States with relevant penalty statutes, during periods not covered by statutes of limitation.[117] As noted above, however, even if one were able to identify the incremental profits reliably, they are not necessarily sufficient to determine an appropriate deterrent amount for two primary reasons. First, the amount of harm may be significantly greater than the incremental profits earned by Google; and second, the total volume of affected commerce may be significantly greater than the volume of commerce generating the incremental revenues or profits earned by Google.

(70) With regard to the latter, consider for example, a mortgage lender who falsely claims to have performed the due diligence required by a state regulator on all 100 loans that it originates; and as a result of its failure to perform the due diligence, it issues an additional two loans to non-creditworthy borrowers. The total volume of affected commerce is that volume to which the conduct was applied, which, in the example above, is all 100 loans, even though the conduct only generated an additional two loans that would not have been issued had the lender performed the required due diligence. For purposes of establishing an appropriate deterrent penalty, the value of the 100 loans is as relevant, and likely even more relevant, than the value of the incremental two loans, as it provides a measure of the full extent of the conduct at issue.

(71) Similarly, in this case, while the conduct at issue likely generated significant additional booked revenues and net revenues for Google (far in excess of the amounts estimated by Dr. Wiggins, as I demonstrate further below), a deterrence analysis should not be solely limited to an analysis of

[117] Wiggins Report, § VII and Appendix D.

these incremental benefits. Given the centrality of auction design—and the public's understanding of the way in which prices are determined in an auction—in determining the bids submitted by both buyers and sellers, if market participants had been aware of the programs implemented, they would have likely submitted different bids.[118] Different auction rules generally result in different bidding behavior. Dr. Wiggins appears to recognize that in his analysis of "bid shading" between first- and second-price auctions; and even in his assertion that bidders would have changed their bidding strategies, as they observed unexpected auction outcomes (e.g., prices and quantities inconsistent with second-price auctions).[119] In addition, if auction participants were induced to use AdX rather than competing exchanges on the assumption that Google was running a (clean) second-price auction, when in fact it was not, then Google's total amount of booked revenues on AdX is relevant in assessing the severity and extent of the conduct at issue.[120] Thus, all of Google's booked revenues associated with the conduct at issue are relevant in assessing the full scope of the potential harm, as they provide an indication of the volume of commerce likely affected by the conduct at issue, regardless of whether the clearing prices or volumes changed on each and every one of the underlying transactions. For the same reason, Google's total net revenues, gross profits, and operating profits are also relevant in assessing the scope of its conduct and its actual or potential benefits.

(72) In responding to Dr. Wiggins's and Dr. Skinner's analysis of Google's revenues and profits for the potentially affected Ad Tech products, I use Google's internal profit and loss statements ("P&Ls") for DVAA, which is Google's product area that includes Ad Tech products but excludes its Search, YouTube, Play, or Cloud-related products.[121] Google considers "Ad Tech Products" to refer to "independent products that Google and third parties provide to publishers or advertisers to facilitate the sale and purchase of display advertising inventory" and considers it to include the following products: "Google Ads (solely as used for the purchase of display advertising, not search ad inventory), Display & Video 360, Campaign Manager, AdSense for Content (but not, for the avoidance of doubt, AdSense for Search), AdMob, and Google Ad Manager."[122] I follow Mr. Andrien's approach to estimating Google's revenues and profits from the sale of its Ad Tech products.[123]

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[118] See the Weinberg Report for his detailed conclusions and Weinberg Report, § I.D for a summary.

[119] Wiggins Report, Appendix D.

[120] Dr. Weinberg's Rebuttal Report explains that, in addition to some participants changing their behavior in response to the deceptive conduct, some participants may be on Google's platform because of the deceptive conduct; *see* Weinberg Rebuttal Report, § IV.G.

[121] Andrien Report, ¶ 92.

[122] First Amended Responses and Objections to Plaintiffs' Third Set of Interrogatories, May 24, 2024, p. 4.

[123] I use the 2013–2021 DVAA P&Ls from the Andrien Report and updated 2022–2023 DVAA P&Ls from the Skinner Report. I understand that Mr. Andrien is using an updated 2021 DVAA P&L for his rebuttal report but the differences between his updated and previous 2021 DVAA P&L are small. *See* Expert report of Jeffrey S. Andrien, September 9, 2024 [hereinafter "Andrien Rebuttal Report"].

(73) Figure 5 shows the revenue and profit metrics for Google's Ad Tech products. These products comprise a substantial volume of commerce, generating total booked revenues of over [redacted] from December 2013 to 2023. This broader amount of booked revenue provides one measure of the total volume of commerce potentially directly affected by the conduct at issue, since it represents the total amount of revenue paid to Google by advertisers. After accounting for traffic acquisition costs ("TAC") and content acquisition costs ("CAC"), the potentially affected products generated total net revenue of [redacted] for Google over these years. With regard to the profitability of Google's Ad Tech business, I consider two alternative measures of profits: gross profit (which is net revenues less cost of goods sold); and operating profit (which is gross profit less other operating expenses, including sales, marketing, and general administrative expenses).[124] Gross profit can often be used to assess the incremental profits contributed by certain conduct, if that conduct leads to incremental revenue (e.g., by raising prices or diverting sales from a competitor) without also increasing the operating costs (e.g., without requiring additional marketing and sales efforts to obtain those higher prices or to compete for those additional sales from a competitor). From December 2013 to 2023, for its DVAA business, Google recorded total gross profit of [redacted] and total operating profit of [redacted].

Figure 5: Google DVAA P&L

Year	Booked Revenue ($ million)	Net Revenue ($ million)	Gross Profit ($ million)	Operating Profit ($ million)
2013	[redacted]			
2014				
2015				
2016				
2017				
2018				
2019				
2020				
2021				
2022				
2023				
Total				

Source: Andrien Report backup for Exhibit 2 (2013–2021). Skinner Report backup for Table 4B (2022–2023).
Notes: [1] Includes Adsense for Content, AdX, Doubleclick Bid Manager, AdMob, Doubleclick for Publishers, AdServing, Ad Manager, AwBid, Display & Video 360, Campaign Manager, and Google Ads.

[124] *See* Andrien Report, Exhibit 2.

[2] Since the earliest start date for a DTPA claim is November 11, 2013 for Bernanke, 2013 line items equal the value of the source P&L line items multiplied by 1/12.

(74) Dr. Wiggins and Dr. Skinner assume that only three products were affected by Google's conduct at issue: AdX, Google Ads, and DV360.[125] However, as discussed above, they do not explain why Google's revenues and profits associated with Ad Tech products would not have been affected, since they are integrated into the same digital advertising ecosystem. The excluded products—AdMob, AdSense, and CM360—account for [redacted] of net revenue, [redacted] of gross profit, and [redacted] of operating profit for Google Display Advertising in 2023.[126] A 2019 Google document regarding the DVAA P&Ls describes the "DVAA product suite" as "a result of acquisitions to play across the entire marketer-to-publisher chain."[127] The same document also clarifies the linkages between the three products excluded by Dr. Wiggins and Dr. Skinner and the rest of the DVAA ecosystem.[128]

(75) Moreover, the scope of the affected volume of commerce by the conduct at issue could be much greater than Google's Ad Tech revenues described above. There are some types of products, and some types of conduct, for which it is straightforward to identify the volume of commerce affected by that conduct. For example, if a company CEO fraudulently misrepresents its financial performance in order to increase the company's stock price, the commerce affected by that fraud is likely limited to the trading of that company's stock, not the stock of other companies; or if a producer of a lamp contends that it tested the lamps to comply with a given standard (e.g., the UL standard), but it had not, then the affected volume of commerce is likely limited to the revenues from the sale of the lamps at issue. Here, however, the task is more complicated because of the interconnected nature of the products and markets. Since the core product at issue, AdX, is at the intersection of many different products and technologies, and it is the software that executes transactions that flow through other products (from which Google also generates profits), the volume of affected commerce is likely to be considerably greater than simply the amount of AdX booked revenue, and likely includes revenues from other Google Ad Tech products, as calculated above. Furthermore, given the integration of Google's Ad Tech products into both its Ad Tech business serving third-party publishers and its sales of advertising on its own properties, as discussed above, the volume of

[125] Dr. Wiggins includes only Google's revenues from AdX, Google Ads, and DV360 in his calculation of Google's per-transaction revenue, which is then used as an input to his per-violation penalty estimate. Wiggins Report, Table 2. Similarly, Dr. Skinner argues that these three products are the "at-issue DVAA products." Skinner Report, ¶ 50 and Table 3.

[126] See my backup materials for details.

[127] GOOG-AT-MDL-001057220, at -7247.

[128] *See*, e.g., GOOG-AT-MDL-001057220, at -7248 ("Advertiser uses DoubleClick Campaign Manager (DCM) to manage spend across multiple DSPs. Some of that money might then use DoubleClick Bid Manager (DBM) [now part of DV360] to purchase inventory via Ad Exchange (AdX) to buy an ad slot managed by DoubleClick for Publishers (in which case it can be purchased via Ad Exchange or by another Network/SSP)."

affected commerce may extend beyond the Ad Tech revenues to also encompass Google's advertising on its own properties, such as YouTube, Gmail, or Search.

(76) Figure 6 compares the booked revenue of Ad Tech products with Google's advertising revenue by segment reported in its 10-K filings. Booked revenues from Google Network Members' properties provide a useful measure for the volume of commerce likely affected directly by the conduct at issue, because they consist primarily of advertising revenues generated from ads placed on Google Network Members' properties through AdMob, AdSense, and Google Ad Manager (DoubleClick AdExchange for earlier years).[129] According to the company's 10-K, from December 2013 to 2023, Google generated total booked revenue of over $224 billion from Google Network Members' properties, which is [redacted] more than the total revenue from its Ad Tech products reflected in the DVAA P&Ls Google has provided in discovery (as summarized in Figure 5, above). I have not been able to identify what accounts for the difference. Of even greater potential importance, however, is that Google also generated an additional $1.2 trillion in booked revenue during the period at issue from advertising on Google websites, such as its YouTube, Gmail, and Search properties. In total, Google earned approximately $1.4 trillion in booked revenue over the years at issue, more than seven times Google's revenue from Ad Tech products considered alone. As I discuss in Sections III.C and III.D, to the extent that Google's conduct at issue implicated the advertising on its own websites, e.g., via the use of its Ad Tech tools to direct display advertisements to YouTube or Gmail, for example, or Google Search via its other conduct at issue, the potential volume of affected commerce may be considerably larger than the Ad Tech or Google Network booked revenues alone would otherwise suggest.

[129] *See*, e.g., Alphabet Inc., *Form 10-K 2017*, February 6, 2018, 54 and Alphabet Inc., *Form 10-K 2021*, February 2, 2022, 55.

Figure 6: Google's Advertising Revenue y Segment, 2013–2023

Year	Booked Revenue, DVAA ($ million)	Booked Revenue from 10-K Filings		
		Google Network ($ million)	Google Websites ($ million)	Total ($ million)
2013	[redacted]	$1,138	$3,119	$4,256
2014		$14,539	$45,085	$59,624
2015		$15,033	$52,357	$67,390
2016		$15,598	$63,785	$79,383
2017		$17,616	$77,961	$95,577
2018		$20,010	$96,451	$116,461
2019		$21,547	$113,264	$134,811
2020		$23,090	$123,834	$146,924
2021		$31,701	$177,796	$209,497
2022		$32,780	$191,693	$224,473
2023		$31,312	$206,543	$237,855
Total		$224,364	$1,151,888	$1,376,251

Source: Andrien Report backup for Exhibit 2 (2013–2021). Skinner report backup for Table 4B (2022–2023). Alphabet Inc., Form 10-K filings, 2015-2023.
Notes: [1] Booked Revenue for Ad Tech Includes Adsense for Content, AdX, Doubleclick Bid Manager, AdMob, Doubleclick for Publishers, AdServing, Ad Manager, AwBid, Display & Video 360, Campaign Manager, and Google Ads.
[2] Booked Revenue from 10-K Filings for Google Network consists primarily of advertising revenues generated from ads placed on Google Network Members properties through AdMob, AdSense, and Google Ad Manager (DoubleClick AdExchange for earlier years).
[3] Since the earliest start date for a DTPA claim is November 11, 2013, for Bernanke, 2013 line items equal the value of the source P&L line items multiplied by 1/12.

(77) Figure 7 compares the operating profit of Google's Ad Tech products with Google's total advertising operating profits and its estimated operating profit by segment. Note that I have estimated the operating profits listed for the Google Network and Google Websites, since Google does not report profits separately for these segments on its 10-Ks.[130] From December 2013 to 2023, Google generated $517 billion in total operating profit from advertising, of which, as reported below, [redacted], and $506 billion is from Google Websites. While Google appears to use some of its Ad Tech products to advertise on its own websites, from my review of the available financials, [redacted]

[130] I estimate Google's operating profit from Google Network properties by scaling up the operating profit from its Ad Tech products using the revenue ratios shown in Figure 6. This approach may overstate the amount of operating losses in some of the earlier years for Google Network, and thus understate the total amount Google Network operating profits, since there are substantially more revenues for Google Network during those years than is recorded for DVAA; and it is unclear what, if any, additional expenses may be associated with those additional revenues, and whether the amount of such additional expenses exceeded the additional revenues.

[redacted] If the company uses the Ad Tech products in selling advertising space on its own websites, and does not record intercompany payments for the use of those products, the operating profit of the Ad Tech (or DVAA) business will be significantly understated; given the large volume of Google's own website advertising, if operating at arm's length, the Ad Tech business (either DVAA or Google Network as a whole) would at least charge the Google Websites an amount sufficient to recover a substantial fraction of the Ad Tech business' cost, and likely substantially more, given the take rate of Google's Ad Tech products when charged to third parties.

Figure 7: Google's Advertising Operating Pro it y Segment, 2013–2023

Year	Operating Profit, DVAA ($ million)[1]	Operating Profit		
		Google Network (est.)[2] ($ million)	Google Websites (est.)[4] ($ million)	Total[3] ($ million)
2013	[redacted]			
2014				
2015				
2016				
2017				
2018				
2019				
2020				
2021				
2022				
2023				
Total				

Source: Andrien Report backup for Exhibit 2 (2013–2021). Skinner report backup for Table 4B (2022–2023). Alphabet Inc., Form 10-K filings, 2015-2023. S&P Capital IQ.
Notes: [1] Operating Profit for Ad Tech Includes Adsense for Content, AdX, Doubleclick Bid Manager, AdMob, Doubleclick for Publishers, AdServing, Ad Manager, AwBid, Display & Video 360, Campaign Manager, and Google Ads.
[2] Google Advertising Operating Profit from Google Network is estimated using the annual Ad Tech Operating Profit multiplied by (2013–2023 Booked Revenue of Google Network Members' properties / 2013–2023 Booked Revenue of Google DVAA products).
[3] Total Google Advertising Operating Profit is estimated as the total Operating Income Before Tax for Google, Google Cloud, and Google Services from S&P Capital IQ.
[4] Advertising Operating Profit from Google Websites is estimated as total Operating Profit from Google Advertising minus Total Operating Profit from Google Network.
[5] Since the earliest start date for a DTPA claim is November 11, 2013 for Bernanke, 2013 line items equal the value of the source P&L line items multiplied by 1/12.

(78) The revenues and profits provided above provide an indication of the potential total volume of commerce actually or potentially affected, directly or indirectly, by the conduct at issue, but it does

not identify the portion of that volume of commerce associated with the Plaintiff States. Performing such an allocation for purposes of evaluating or deriving a statutory penalty amount, however, is complicated due to several conceptual issues. There are many parties involved in, and affected by, the display advertising in the auctions in which Google's Ad Tech products are used, i.e., publishers, advertisers, and consumers, as well as Google itself, including Google equipment (servers), facilities, and people. Thus, there are multiple, overlapping, and alternative pathways in which Google's revenues and profits associated with its Ad Tech products could be allocated to the Plaintiff States in this context.[131] For example, for a given AdX transaction, the transaction or revenues may pertain to: advertisers or advertising agencies located within the Plaintiff States; publishers or their advertising agencies within those states; individuals (whether as consumers or as employees of businesses) who see the advertisements, and whose data are used in the advertising algorithms to generate additional revenues for Google, the publishers, and the advertisers; or Google itself, via the servers on which either the auctions themselves are transacted, on which the data used in the transactions are stored, or via other data processing and storage mechanisms. Thus, an appropriate allocation of the affected commerce to Plaintiff States for purposes of applying the relevant statutes may result in a far greater amount of transactions, revenues, or profits than an allocation performed for other purposes, such as an allocation for state tax purposes. Because of the number of Plaintiff States, I expect a relatively large fraction of U.S. transactions would likely be related to the Plaintiff States through at least one of the channels mentioned above. If that is the case, Mr. Andrien's allocations to the Plaintiff States in his Table 1 will significantly understate the commerce at issue associated with the Plaintiff States. Nonetheless, as a lower bound, I adopt Mr. Andrien's approach below.

(79) Figure 8, below, shows the allocation of Google's revenues from potentially affected products to the Plaintiff States, following Mr. Andrien's allocation methodology.[132] The first columns shows that the total booked revenue from Google's Ad Tech products associated with the Plaintiff States is [redacted] for 2013–2023.[133] As I describe above and show in Figure 6, the potentially affected volume of commerce could be captured in the advertising revenues from Google Network Members' properties or Google Websites. Using Mr. Andrien's methodology, the total revenues associated with the Plaintiff States would be [redacted] for Google Network Members' properties, [redacted] for Google Websites, and $189.7 billion for Google's advertising business as a whole.

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[131] Dr. Wiggins recognizes that the Plaintiff States can be affected by Google's alleged conduct in multiple, overlapping ways, but only uses the location of advertisers in his allocation of affected transactions to the Plaintiff States. Wiggins Report, § IV.D.

[132] Andrien report, ¶¶ 94–95 and Table 1.

[133] These columns correspond to Table 1 in Andrien report except 2022–2023, where I use Dr. Skinner's corrected P&L metrics.

Figure 8: Estimated Google revenue y segment associated with Plainti States, 2013–2023

Year	Booked Revenue, DVAA ($ million)[1]	Google Advertising Revenue		
		Google Network ($ million)[2]	Google Websites ($ million)[4]	Total ($ million)[3]
2013	[redacted]			$540
2014				$7,337
2015				$8,819
2016				$10,773
2017				$13,038
2018				$15,653
2019				$18,295
2020				$19,966
2021				$29,254
2022				$32,061
2023				$33,918
Total				$189,653

Source: Andrien Report, backup for Table 1, Exhibit 2. Skinner backup for Table 4B. Alphabet Inc., Form 10-K filings, 2015-2023. S&P Capital IQ.
Notes: [1] Booked Revenue for Ad Tech is estimated following Andrien's approach for Table 1, replacing 2022–2023 revenues with Skinner's backup for Table 4B. It includes Adsense for Content, AdX, Doubleclick Bid Manager, AdMob, Doubleclick for Publishers, AdServing, Ad Manager, AwBid, Display & Video 360, Campaign Manager, and Google Ads.
[2] Google Advertising revenue from Google Network is estimated using the annual Ad Tech Booked Revenue multiplied by (2013–2023 Booked Revenue of Google Network Members' properties / 2013–2023 Booked Revenue of Google DVAA products).
[3] For a given year, total Google Advertising Revenue is estimated as Google's worldwide advertising revenues from 10-K filings * (% of Google's revenues in the U.S.) * % of U.S. internet subscribers in the Plaintiff States using Andrien backup for Table 1.
[4] Advertising Revenue from Google Websites is estimated as total Google advertising revenue minus total advertising revenue from Google Network.
[5] Since the earliest start date for a DTPA claim is November 11, 2013, for Bernanke, 2013 line items equal the value of the source P&L line items multiplied by 1/12.

(80) Figure 9 shows the allocation of Google's operating profit from potentially affected products associated with the Plaintiff States, following Mr. Andrien's methodology. The total operating profits from Google's Ad Tech products associated with the Plaintiff States are estimated to be [redacted] for December 2013–2023.[134] Using Mr. Andrien's methodology, Google's total operating profits in advertising associated with the Plaintiff States for December 2013–2023 are [redacted], of which [redacted] are from Google Network Members' properties and the remaining [redacted] from Google Websites.

[134] These columns correspond to Table 1 in Andrien report except 2022–2023, where I use Dr. Skinner's corrected P&L metrics.

Figure 9: Estimated Google Operating Pro it y segment associated with Plainti States, 2013–2023

Year	Operating Profit, DVAA ($ million)[1]	Google Advertising Operating Profit		
		Google Network ($ million)[2]	Google Websites ($ million)[4]	Total ($ million)[3]
2013	[redacted]	[redacted]	[redacted]	$2,064
2014	[redacted]	[redacted]	[redacted]	$2,334
2015	[redacted]	[redacted]	[redacted]	$3,052
2016	[redacted]	[redacted]	[redacted]	$3,671
2017	[redacted]	[redacted]	[redacted]	$4,427
2018	[redacted]	[redacted]	[redacted]	$5,798
2019	[redacted]	[redacted]	[redacted]	$6,650
2020	[redacted]	[redacted]	[redacted]	$7,420
2021	[redacted]	[redacted]	[redacted]	$12,307
2022	[redacted]	[redacted]	[redacted]	$11,812
2023	[redacted]	[redacted]	[redacted]	$13,669
Total	[redacted]	[redacted]	[redacted]	$73,203

Source: Andrien backup for Table 1, Exhibit 2. Skinner backup for Table 4B. Alphabet Inc., Form 10-K filings, 2015-2023. S&P Capital IQ.
Notes: [1] Operating Profit for Ad Tech are estimated following Andrien's approach for Table 1, replacing 2022–2023 revenues with Skinner's backup for Table 4B. It includes Adsense for Content, AdX, Doubleclick Bid Manager, AdMob, Doubleclick for Publishers, AdServing, Ad Manager, AwBid, Display & Video 360, Campaign Manager, and Google Ads.
[2] Google Advertising Operating Profit from Google Network is estimated as Ad Tech Operating Profit * (2013–2023 Booked Revenue of Google Network Members' properties / 2013–2023 Booked Revenue of Google DVAA products).
[3] For each year, total Google Advertising Operating Profit is estimated as Google's worldwide advertising operating profit (from Google Services and Google) from Capital IQ * (% of Google's revenues in the U.S.) * % of U.S. internet subscribers in the Plaintiff States.
[4] Google Advertising Operating Profit from Google Websites is estimated as total Google advertising Operating Profit minus total advertising Operating Profit from Google Network.
[5] Since the earliest start date for a DTPA claim is November 11, 2013 for Bernanke, 2013 line items equal the value of the source P&L line items multiplied by 1/12.

V. Number of affected transactions and potential statutory violations

(81) As discussed above, from an economic perspective, Dr. Wiggins takes an inappropriately narrow view of the relevant transactions that are potentially affected by the alleged conduct. Based on that overly narrow view, Dr. Wiggins concludes, "Mr. Andrien vastly overstates the number of affected transactions."[135] As discussed above, in determining an appropriate deterrent amount, it is important to assess both the total number of transactions affected by the alleged conduct ("N"); and the

[135] Wiggins Report, § IV.H. See Wiggins Report, § IV for a detailed discussion of Dr. Wiggins's calculations.

number of potential violations under the relevant Plaintiff States' statutes ("n"). With regard to the number of violations ("n"), Dr. Wiggins fails to distinguish between the number of affected *transactions*, i.e., auctions (which are appropriately "de-duplicated" in working backwards from Google's multiple types of conduct at issue); and the number of potential statutory *violations*. Since Google implemented multiple programs in a single auction, the jury may decide that each such auction consisted of multiple violations (i.e., multiple acts of deception). Ultimately, it is up to the jury, not Dr. Wiggins, to decide whether each of the programs at issue constitutes a separate statutory violation when Google's AdX product executes a transaction; or whether each auction affected by any of Google's conduct should be considered at most one violation. In my calculations below, I show the impact on the number of violations, if the jury decides either the former or the latter is applicable. Furthermore, as in the above discussion regarding an evaluation of the scope of the conduct at issue, while it is important identify the number of potential statutory violations, it is also relevant to consider the full extent of Google's conduct at issue (i.e., "N"), as that full extent is what likely reflects the total benefits to Google and harm to others. That assessment, in turn, helps to inform an analysis of the appropriate deterrent amount. In this section, I provide estimates of both of these measures of the extent of Google's content.

V.A. Dr. **Wiggins's** methodology for calculating the number of affected transactions is based on incorrect assumptions

(82) Dr. Wiggins argues that the number of transactions affected by Google's alleged conduct is 579 billion. In this section, I summarize the methodology he uses to arrive at this estimate, and I describe the flaws in this methodology.

(83) Mr. Andrien estimates a total of [redacted] affected transactions associated with Plaintiff States by calculating the ratio of each Plaintiff State's internet population to that of the United States as a whole; and then applying that ratio to the total number of open auction transactions during the period at issue (December 2013 through May 2024).[136] Dr. Wiggins arrives at his estimate of 579 billion by applying seven "corrections" to Mr. Andrien's estimated number of affected transactions.[137] His calculation is inappropriate when determining the number of affected transactions for two reasons. First, while it is appropriate to restrict the transaction counts to the Plaintiff States for purposes of deriving the number of statutory violations, to derive the total number of affected transactions, he ignores the global scope of the conduct ("N"), which is relevant in assessing the overall severity and extent of the conduct, and in deriving an appropriate deterrent penalty. Second, several of his "corrections" ignore the interconnectedness of Google's Ad Tech ecosystem (also

[136] Andrien Report, ¶ 97, ¶ 99, and Table 2.

[137] Wiggins Report, Table 1.

discussed above) and assume that the impact of Google's alleged conduct is isolated to selected products.

(84) Dr. Wiggins makes two "corrections" in particular that inappropriately reduce the number of transactions in his calculations: his "correction 2," which excludes in-app transactions; and his "correction 7," which overly narrows the range of potentially affected transactions. Removing these two "corrections" results in a lower-bound estimate of the number of transactions impacted by the alleged deception in the Plaintiff States, although it does not necessarily provide a number of potential violations in those states (since many transactions involve multiple conduct at issue).

(85) Dr. Wiggins's "correction 2" excludes in-app transactions in his transaction counts. Although Dr. Wiggins cites to Mr. Andrien's report in defense of this decision, he does not provide any evidence that Google's conduct at issue did not occur on mobile apps.[138] It is my understanding that AdX is also used for in-app advertisements.[139] Google's internal documents also suggest that in-app transactions were targeted by the conduct at issue.[140]

(86) Dr. Wiggins's "correction 7" limits the transaction count by identifying types of transactions that he claims were unaffected by the alleged deception.[141] As noted in Section III, however, Google's Ad Tech products operate within a highly integrated and cohesive "ecosystem," which means that when transactions are impacted by Google's conduct in one part of that ecosystem, it is likely that many other, if not all, transactions will be at least indirectly affected. Therefore, Dr. Wiggins's claim that only some of the transactions were affected cannot be assumed to be true.

(87) I also provide an alternative version of transaction counts by relying on Mr. Andrien's penalty period, which Dr. Wiggins's modifies in his "correction 5." By focusing on these three corrections, I am not accepting Dr. Wiggins's other four corrections but rather providing a lower bound of the number of potentially affected transactions.

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[138] Wiggins Report, § IV.B. "Compare Ad Manager, AdSense, and AdMob," *Google Support*, accessed August 21, 2024, https://support.google.com/admanager/answer/9234653?hl=en.

[139] "Compare Ad Manager, AdSense, and AdMob," *Google Support*, accessed August 21, 2024, https://support.google.com/admanager/answer/9234653?hl=en.

[140] An internal email chain from April 2017 discusses the plan to "roll out Regular Bernanke on AdMob" and states that "[w]e are roughly targeting end of August." GOOG-NE-07249237, at -9237. A 2019 employee performance review document confirms that Bernanke was implemented on AdMob: "Bernanke originally applied to the special case of one buyer (AdWords) bidding on one seller (AdX)…In 2018 I led projects to extend Bernanke to work on Gmob (app install) buyers and AdMob (Google's mobile app publisher) sellers." GOOG-DOJ-AT-02218994, at -8996.

[141] Wiggins Report, § IV.G.

V.B. Corrections to Dr. Wiggins's estimates of affected transactions and potential statutory violations

(88) To understand the full scope of Google's conduct at issue (i.e., "N," as defined above), I first calculate the overall number of AdX open auction transactions that are potentially impacted in Figure 10 below. It shows that Google's alleged conduct affects almost all AdX global open auction transactions after correcting for Dr. Wiggins's inappropriate modifications. Expanding Dr. Wiggins's transaction counts to include all global transactions (i.e., by undoing his "corrections" 1, 3, 4, and 6) results in over [redacted] transactions, or [redacted] of global AdX transactions over the course of his defined penalty period.[142,143] Additional adjustments to include in-app transactions increase the number and percentage of potentially affected transactions to [redacted] and [redacted] respectively; and further accounting for the entire Ad Tech ecosystem increase these further to [redacted], or [redacted] of all AdX transactions in Dr. Wiggins's proposed penalty period. When using Mr. Andrien's conduct period, the count of potentially affected transactions increases to [redacted], or [redacted] of all AdX transactions in that period.

Figure 10: Glo al AdX open auction transactions potentially a ected y Google's conduct at issue during the Wiggins conduct period

Transactions included	"De-duplicated" transaction counts	Percent of global transactions
Dr. Wiggins's proposed global transaction count	[redacted]	[redacted]
Excluding "correction" 2	[redacted]	[redacted]
Excluding "corrections" 2 and 7	[redacted]	[redacted]
Excluding "corrections" 2, 7, and 5	[redacted]	[redacted]

Source: Wiggins Report backup for Table 1.
Notes:
[1] Dr. Wiggins's proposed global transaction count is the number of worldwide AdX open auction transactions, limited to (1) web transactions, (2) transactions in his proposed corrected time period, and (3) potentially affected transactions.
[2] No restrictions have been made to account for the plaintiff states' relative share of transactions. This includes limitations to account for (1) states that can recover B2B civil penalties, (2) corrections using the location of the advertiser, or (3) the plaintiff states' statutes of limitations.
[3] Percent of global transactions is the number of de-duplicated transactions divided by the total number of AdX open auction transactions between the onset of the earliest deceptive program and end of the latest deceptive program. The first three sets of transactions included rely on Dr. Wiggins's modified penalty period. The transaction counts for "Excluding corrections 2, 7, and 5" relies on Mr. Andrien's conduct period and contain more total global transactions than the other scenarios.

(89) As I describe in Section I, the total number of transactions potentially or actually affected by the conduct at issue ("N") provides one measure of its overall severity, while the number of actionable

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[142] Dr. Wiggins's "correction 1" limits the transactions to U.S. AdX transactions. Correction 3 limits the count of transactions to states that can recover civil business-to-business penalties. Correction 4 relies on the location of advertisers to calculate the Plaintiff states' share of transactions. Correction 6 limits the transaction count by accounting for the states' statutes of limitations. All four of these corrections are not relevant when considering the global number of transactions impacted by the deceptive programs. Wiggins Report, § IV.

[143] Penalty period defined using Dr. Wiggins's modified penalty period. *See* Wiggins Report, § IV.E.

transactions within each of the Plaintiff States with per violation statutory violations ("n") may impose a limit on the amount of the statutory penalties that the Plaintiff States can impose. In the discussion below, I show that Dr. Wiggins's estimates of actionable transactions in the Plaintiff States understate the severity and extent of harm from Google's alleged conduct.

(90) Throughout the analysis below, I incorporate Dr. Wiggins's "correction 3" (limiting the number to those states that can recover civil penalties for business-to-business transactions), "correction 4" (changing the percentage allocated to Plaintiff States to account for locations of advertisers), and "correction 6" (accounting for each Plaintiff States' statutes of limitations).[144] "Correction 3" and "correction 4", when applied individually, lead to a reduction in de-duplicated transaction counts from Mr. Andrien's estimate of 84.0% and 30.7% respectively.[145] Whether the Plaintiff States have a right to assess penalties for the conduct in the transactions Dr. Wiggins excluded based on his corrections 3 and 6 is ultimately a legal matter, but these transactions are still relevant in assessing the extent of the conduct in the Plaintiff States and thus in a deterrence analysis.

(91) Figure 11 shows that excluding Dr. Wiggins's "corrections" 2 and 7, i.e., including in-app transactions and accounting for the entire Ad Tech ecosystem, increases the lower-bound count of AdX transactions in the Plaintiff States to over [redacted]. For purposes of assessing penalties, however, the relevant measure is the number of statutory violations in the Plaintiff States, and the jury may decide that Google's conduct resulted in multiple violations in a single transaction. Excluding these two "corrections" by Dr. Wiggins would result in a lower bound count of [redacted] affected transactions, and a lower-bound count of [redacted] potential violations in the Plaintiff States during Dr. Wiggins's proposed penalty period. Additionally, if the jury were to decide that Mr. Andrien's conduct period were appropriate, the lower-bound count of affected transactions in the Plaintiff States increases to [redacted], and the lower-bound count of potential violations in the Plaintiff States increases to [redacted].

[144] *See* Wiggins Report, § IV.

[145] Wiggins Report, Table 1.

Figure 11: Modi ications to Dr. Wiggins's proposed AdX open auction transaction count in the Plainti States

Transactions included	De-duplicated transaction counts	Violation counts
Dr. Wiggins's proposed transaction count	[redacted]	[redacted]
Excluding “correction” 2	[redacted]	[redacted]
Excluding “corrections” 2 and 7	[redacted]	[redacted]
Excluding “corrections” 2, 7, and 5	[redacted]	[redacted]

Source: Wiggins Report backup for Table 1.
Notes:
[1] Dr. Wiggins's proposed transaction count is his reported number of AdX open auction transactions impacting the Plaintiff States, according to his seven corrections. *See* Wiggins Report, Section IV.
[2] Violation counts represent the number of unique violations, whereas de-duplicated transaction counts represent the number of unique transactions. For example, if there were 500 total transactions in a month where two deceptive programs were active, there would be 500 de-duplicated transactions and 1,000 violations.

(92) As I describe in Sections III and IV, the volume of commerce impacted by the conduct could include much more than the Ad Tech products directly affected by the alleged conduct. Dr. Wiggins's transaction counts are limited to AdX transactions, but as discussed above, there are non-AdX transactions that were likely impacted by the deception, such as those occurring through the Google Display Network. Moreover, the conduct at issue likely also affected Google's advertising revenues and profits on Google Search, and other products that use AdWords, which would increase substantially the number of affected transactions. Lastly, as Dr. Weinberg explains, Google's conduct enabled it to accumulate additional data on users, advertisers, and publishers, which allowed Google to optimize its algorithms to increase ad targeting and personalization, and thus increase revenue across all its businesses.[146]

(93) In assessing even these exceptionally large numbers of affected transactions or potential violations, it should be noted that any allocation of the affected transactions to a particular state's jurisdiction is complicated due to several conceptual issues, as raised above in the discussion of the allocation of revenues and profits to the Plaintiff States. In deriving what he considers to be the number of affected transactions in the Plaintiff States (which he uses in calculating his proposed penalty amounts of between \$44.9 million and \$141.3 million), Dr. Wiggins only considers the billing address of advertisers in his allocation of affected transactions associated with the Plaintiff States.[147] However, there are many parties involved in, and affected by, the display advertising in the auctions in which Google's Ad Tech products are used: publishers, advertisers, consumers, and Google itself. A transaction for advertising space appearing on the Dallas Morning News (the publisher) could be reasonably considered a transaction allocable to Texas for penalty purposes; as could a transaction involving an advertisement for Coke (for a Georgia-based advertiser) on the Chicago Tribune's

[146] Chandler Report, ¶ 284.

[147] Wiggins Report, ¶ 128.

website when viewed by Texas resident; or a transaction involving an advertisement by a Houston car dealership; or transactions involving non-Texas parties on Google's servers located in Texas that are running the auctions using the programs at issue or storing the data used in those programs. Thus, there are multiple, alternative pathways by which each transaction associated with its Ad Tech products could be allocated to the Plaintiff States in this context. Thus, any single exclusive allocation method of the affected transactions to Plaintiff States for purposes of applying the relevant statutes, such as the method used by Dr. Wiggins, will understate, and likely substantially underestimate, the number of relevant transactions and violations within the Plaintiff States.

(94) Regardless of whether Mr. Andrien's initial estimates of the number of statutory violations ("n") are correct, or Dr. Wiggins's corrections of Mr. Andrien's numbers are correct, or my corrections of Dr. Wiggins's numbers are correct, from the perspective of determining the appropriate deterrence penalty, the overall conclusion would be the same: the number of statutory violations is so large, even if one were to accept Dr. Wiggins's estimate of 579 billion, that we are effectively in the flat part of the aggregate penalty curve discussed above in Figure 1. Furthermore, the broad scope of the conduct at issue in terms of the total number of auctions affected, over a period of many years, with multiple overlapping instances of different conduct, and accounting for a substantial fraction of all programmatic advertising, all points to the need for a substantial deterrent penalty amount, far above the minimal amounts proposed by Dr. Wiggins.

VI. Penalties necessary for deterrence are far above the amounts suggested by Dr. Wiggins

VI.A. **Dr. Wiggins**'s **estimate of Google's benefits from the conduct is** unreliable

(95) Dr. Wiggins proposes three penalty estimates based on Google's alleged conduct, ranging from $21.7 million to $141.3 million.[148] Ultimately, however, Dr. Wiggins concludes "that none of the alleged deception in this case generated incremental profits for Google, and thus that the appropriate DTPA civil penalty based on Mr. Andrien's framework is zero."[149] All three estimates reflect a narrow view of how Google's alleged conduct affects the Ad Tech ecosystem and other entities in the marketplace. Dr. Wiggins derives two of his estimates, $44.9 million and $141.3 million, by applying his revised per-violation penalty amount of $0.000078 to a narrow set of transactions within Google's Ad Tech products, to which Dr. Wiggins assumes the impact of Google's conduct is

[148] Wiggins Report, Figure 6.

[149] Wiggins Report, ¶ 19.

limited.[150] I describe the flaws in his estimated count of affected transactions and the number of potential statutory violations in Section V above, and note that Dr. Wiggins's per-violation penalty contains an inconsistency in the assumed scope of harm.[151] Even setting aside these issues, the penalty amounts Dr. Wiggins derives focus only on the benefits Google derived from a subset of the affected transactions in the Plaintiff States (under the various limitations he imposes). As discussed above, however, to derive an estimate of an appropriate deterrent penalty amount, as a starting point, the appropriate measure of benefits is Google's total benefits from the conduct; which one then needs to divide by the probability of detection, enforcement, and penalty collection. Thus, even if Dr. Wiggins's calculations were reliable (which they are not), they are insufficient for determining an appropriate deterrent penalty amount.

(96) The lowest of the three penalty amounts that Dr. Wiggins estimates, $21.7 million, is also based on flawed assumptions of the channels, scope, and extent of harm from Google's alleged conduct.[152] In terms of channels of harm, Dr. Wiggins estimates Google's incremental profits from the alleged conduct only through its impact on AdX clearing prices but does not estimate any additional profits for Google from retaining publishers or raising the equilibrium price (take rate) due to its competitive advantage. In addition to a "price effect," Dr. Wiggins acknowledges a "quantity effect" of the alleged conduct, i.e., more auctions cleared on AdX than otherwise would have cleared, but-for the alleged conduct.[153] However, he only estimates the quantity effect for one of the deceptive practices—DRS v2.[154] Regarding scope, Dr. Wiggins assumes Google only gained profits through the alleged conduct from transactions won by DV360, Authorized Buyers, and Google Ads.[155] This assumption ignores the indirect impact of Google's alleged conduct throughout the Ad Tech ecosystem. Furthermore, Dr. Wiggins estimates the amount of bid shading ("shading factor") based on the results from a Google experiment that was not conducted to study the impact of any of the alleged deceptive practices.[156] Since the shading factor scales Google's incremental profits, understating its magnitude would underestimate Google's incremental profits from the alleged conduct. Dr. Weinberg, in his rebuttal

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150 The restrictions to the set of affected transactions are described in Wiggins Report, § IV. See discussion above regarding the flaws in these restrictions.

151 Dr. Wiggins's estimated net revenues and total number of transactions are limited to three products (AdX, Google Ads, and DV 360), but "Google's Profit Rate" comes from Google's Display Advertising P&L file for a much broader set of Ad Tech products. Wiggins Report, Table 2.

152 Wiggins Report, Appendix D.

153 Wiggins Report, ¶ 104.

154 Wiggins Report, Appendix D.2.

155 Wiggins Report, ¶¶ 288–300.

156 Wiggins Report, ¶¶ 292–295. For an overview of the Project Poirot where Dr. Wiggins adopts an input for the "shading factor," see GOOG-NE-11275306 at -5306 and GOOG-NE-05279911, at -9917.

report, describes the flaws in Dr. Wiggins's estimate of bid shading and how Dr. Wiggins's estimate of the "shading factor" could be understating the magnitude of shading in the conduct at-issue.[157]

(97) Finally, Dr. Wiggins's claim that Google made no incremental profits from the alleged deception relies on his assertion that publisher and advertiser learning is inconsistent with Plaintiffs' claims about the harm from the alleged conduct (and associated higher profits for Google).[158] This assertion is contradicted by the economic literature and the documents in this case. The academic literature describes the difficulties in measuring advertiser return on investment, highlighting challenges in establishing causality.[159] Internal documents from Google also acknowledge that advertisers find it difficult to understand the drivers of returns to advertising spending and how auction mechanisms affect these returns.[160] More fundamentally, Dr. Wiggins's paradoxical claim rests on the assumption that Google, which according to Dr. Wiggins behaves so as to maximize profits,[161] is investing in the programs at issue without profiting from them. As I discuss below, this assertion is contradicted by Google's own estimates of the substantial additional revenue it derives from these programs. It also runs contrary to Dr. Wiggins's own assertions regarding Google's basic profit motive.

(98) As previously discussed, Dr. Wiggins's claims that Mr. Andrien's "estimated DTPA civil penalties are grossly overstated" and that "Mr. Andrien proposes wildly disproportionate DTPA civil penalties"[162] are based on flawed economic assumptions about the scope of the conduct, the affected transactions, and consumer harm. He also ignores the purpose of the statutory penalties at issue, and particularly their deterrent purpose, as well as a wide range of other factors for the jury to consider that are specified in the relevant statutes. In Section II, above, I outline the economic framework for determining monetary penalties with a view to deterrence. From an economic perspective, calculating the penalty required for deterrence requires two inputs: the estimated total gains to Google from the alleged conduct; and an estimated probability of detection for such conduct. In the remainder of this section, I discuss Google's own estimates for the aggregate effects

157 Weinberg Rebuttal Report, § IV.E.

158 Wiggins Report, §§ II.B and VII, and specifically Wiggins Report, ¶¶ 185, 188, 207–209, 216–218, 222, 228, 231, and 241.

159 *See,* e.g., Randall Lewis, Justin M. Rao, and David H. Reiley, "Measuring the Effects of Advertising: The Digital Frontier," in Economic Analysis of the Digital Economy, ed. Avi Goldfarb, Shane M. Greenstein, and Catherine E. Tucker (Chicago: University of Chicago Press, 2015).

160 A Google document on "June 2018 Auction Tuning" states that advertisers tend to attribute changes in ROI to changes in the world instead of Google's backend auction mechanisms: "A large fraction of advertisers see large swings in core monitoring metrics like CPC, Clicks, Conversion, Impressions over time. They often attribute these changes to things in the world or what they've done, not just things happening on the backend and are mostly satisfied in their ability to take action." GOOG-NE-05047199, at -7202. A 2017 Google document acknowledges that cross channel ROI comparisons are difficult. GOOG-AT-MDL-019569093, at -9094. Another Google document states that "[a]dvertisers do care about the incrementality of their advertising spend, but it is difficult to measure." GOOG-NE-10804189, at -4199.

161 *See,* e.g., Wiggins Report, ¶ 278.

162 Wiggins Report, §§ VI and VII.

of its deceptive practices on revenue, thus incorporating both price effects and quantity effects. I also discuss a reasonable range of estimates for the probability of detection. Based on this information, I derive estimates of deterrent penalties that are consistent with, and even considerably higher than, Mr. Andrien's proposed penalty range, which Dr. Wiggins incorrectly claims to be "wildly disproportionate."[163]

VI.B. Google documents show it earned substantial benefits from the conduct

(99) As noted above in the discussion of the economic literature, there are two ways to begin quantifying the appropriate deterrent amount: (i.) based on the aggregate harm caused by the conduct; or (ii.) based on the aggregate benefits obtained by Google. As discussed above, the scope of harm associated with the conduct indicates that the magnitude of the harm – including the conduct's effect on publishers, advertisers, Google's limited number of competitors, and ultimately consumers – likely exceeds the benefits to Google. The magnitude of that harm, however, is difficult to quantify with any degree of precision. Thus, I focus my attention here on the magnitude of benefits that Google likely obtained from the conduct, which provides a lower bound input for estimating the appropriate deterrent amount (after adjusting for the probability of detection, enforcement, and penalty collection). In addition, while the incremental revenues earned by Google from the conduct at issue may not provide a measure of the *net* benefits obtained by Google (particularly if the incremental revenues are based on booked revenue, rather than net revenue), they may be a general indicator of the potential order of magnitude of the aggregate harm caused by the conduct at issue. This is because incremental revenues, whether measured in terms of booked revenue or net revenue, represent some combination of increased prices paid by advertisers, increased volumes of transactions, increased take rates by Google, and foregone revenues to competitors.

(100) From an economic perspective, in evaluating benefits, one can examine either expected benefits or actual benefits. From a theoretical perspective, the former are likely to be more informative than the latter in determining a deterrent amount; from a practical perspective, however, actual benefits are also informative, since they can reduce the uncertainty associated with estimating various parameters on an *ex ante* basis. I have reviewed documents in which Google employees discuss the expected increase in Google's annual revenues as a result of the conduct at issue. One such document is a presentation titled "Discussion on improving AdX & AdSense backfill," which states that Bernanke added [redacted] queries and increased revenue by [redacted].[164] Another such

[163] Wiggins Report, § VII.

[164] GOOG-NE-03872763 at -2781.

document is an August 2015 presentation titled "Beyond Bernanke"[165] prepared by an engineer on the [redacted] team.[166] The presentation contains a summary of results concerning an experiment conducted by Google to determine the impact of the Bernanke project.[167] These results are sourced from "RASTA,"[168] an experiment-related infrastructure system that Google operates.[169] The document presents comparisons between data generated under the "Bernanke::No_Bernanke" scenario, which does not include the Bernanke program adjustments, and the "Bernanke::Control" scenario, which includes the adjustments.[170] The summary indicates that as a result of the Bernanke program, there was a [redacted] increase in "matched queries," in which an AdWords buyer won the auction relative to all AdX queries.[171] Additionally, there was a [redacted] decline in "matched queries" for non-Google buyers, and a [redacted] increase for AdWords buyers specifically.[172] The presentation estimates that the Bernanke program was responsible for approximately [redacted] in additional revenue per year for GDN (Google Display Network).[173]

(101) I have also reviewed documents that discuss and quantify the expected revenue increases attributable to the RPO[174] and DRS[175] programs. One such document is an October 31, 2015, email written by Google engineer [redacted],[176] who writes that, "The New RPO is increasing revenue from [redacted] generating a network-wide (adx+adsense pubs) revenue lift of [redacted] over the

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165 GOOG-DOJ-28385887.

166 Deposition of Nirmal Jayaram ("Jayaram Depo."), July 10, 2024, 180:17-25.

167 The Bernanke program was implemented based on Google's observation that in auctions won by GDN advertisers, GDN submitted the second highest bid 80% of the time. Therefore, GDN would benefit by minimizing the amount of the second highest bid, which would then lower the payment necessary to win the impression. The savings generated by lowering the amount of the second highest bid were used to subsidize overbidding by GDN advertisers. *See* Weinberg Report, § VIII.

168 GOOG-DOJ-28385887 at -5895.

169 Deposition of Nitish Korula ("Korula Depo."), May 3, 2024, 567:12-17.

170 Jayaram Depo., 182:15-24.

171 Jayaram Depo., 183:3-184:9.

172 Jayaram Depo., 185:9-186:16.

173 GOOG-DOJ-28385887 at -5895 and -5907.

174 The RPO program involved AdX calculating reserve prices for each buyer such that these prices would maximize AdX revenue. AdX would then use these prices in place of the reserve price actually set by the publisher. Publishers did not have the option to opt out of the RPO program, which was originally launched silently. *See* Weinberg Report, § IX.

175 The DRS program involved AdX dynamically decreasing its take rate below 20% to win impressions it would have lost had the take rate remained at 20%. Under the DRS program, if the second highest bid exceeded the reserve price of the ad server but was not high enough to generate a 20% take rate for AdX, AdX would take the difference between the highest bid and the reserve as its fee and pass the reserve to the publisher. In this instance, AdX's fee is necessarily less than 20%. This procedure was updated in DRSv2, which allowed AdX to increase the take rate above 20%, which served to balance the lower fee it charged when reducing its take rate below 20% in other auctions. *See* Weinberg Report, § VII.

176 "[redacted]

past week according to RASTA. That works out to about [redacted] in annual incremental revenue."[177] This estimate was corroborated by the meeting notes of the "DRX Suite Commercialization" team[178] and a November 2015 email[179] from [redacted], then a Google product manager.[180] A March 2016 brief raised this estimate to [redacted].[181] Similarly, an internal Google email exchange dated one week after the launch of DRS stated that DRS was responsible for an additional [redacted] of annual AdX revenue.[182] Google employees later revised this estimate, stating in a May 2016 presentation titled "AdX Auction Optimizations" that the "v1" variant of DRS accounted for [redacted] of revenue.[183] Later in 2016, the estimated benefit of DRS was further revised in the meeting notes of Google's "DRS Sync" team, which state that the DRS program was responsible for approximately [redacted] in additional revenue per year.[184] In a presentation titled "Overall Pub Yield with DRS(v2)," Google employees estimated that DRS was responsible for a [redacted] increase in AdX revenue and a [redacted] increase in AdX profit.[185]

(102) Based on my review of these documents, and my understanding of the conduct at issue, I expect them to reasonably reflect the actual realized and expected future benefits to Google of that conduct. I understand that the results cited in the "Beyond Bernanke" program were generated from an experiment run over a 12-hour window on August 8, 2015 and that, more generally, the estimates in the documents I reference above were based on "small traffic experiments."[186] While the experiment covered a relatively short time period, I nonetheless consider the results to be significant and relevant in assessing both the expected and actual benefits expected from this program, for two reasons. First, Google employees used the estimates in their evaluation of whether a program was successful or not, despite the relatively small time period and thus sample size underlying them.[187] Second, the estimates were derived after the launch of the programs, thereby being based on real data rather than simulated results. Nonetheless, given that the estimates are somewhat variable

177 GOOG-AT-MDL-B-001114919.

178 GOOG-AT-MDL-B-004435235 at -5280.

179 GOOG-NE-04719370.

180 [redacted]

181 GOOG-DOJ-29803801 at -3802.

182 GOOG-TEX-00777528 at -7530.

183 GOOG-NE-06842715 at -2718.

184 GOOG-DOJ-32280412 at -0447.

185 GOOG-NE-13234466 at -4467.

186 Deposition of Nirmal Jayaram, April 26, 2024, 139:12-19.

187 For example, the slide containing the RASTA results with the [redacted] figure is titled "Bernanke Success." *See* GOOG-DOJ-28385887 at -5895.

given the small sample size of the underlying data, I account for this by preparing numerous sensitivities of my analysis, applying different methodologies and assumptions.[188]

VI.C. The probability of detection, enforcement, and penalty collection can be reasonably estimated

(103) As discussed above, in addition to quantifying the expected benefits and harms from a given course of conduct, an important parameter needed to derive an appropriate deterrent penalty amount is the probability of detection, enforcement, and penalty collection. It is difficult to determine precisely the (joint) *ex ante* probability of: (i.) Google's conduct being detected; (ii.) an enforcement action being undertaken; and (iii.) a monetary penalty being assessed and collected.[189] For many types of conduct – and particularly, any conduct that involves deception or concealment – we will never know the full extent of that conduct, since companies and individuals generally do not volunteer that they have engaged in wrongdoing, even if they are no longer liable for that wrongdoing. Nonetheless, statistics are available that can provide reasonable estimates of the *maximum* probabilities of detection and enforcement and thus the *minimum* multiples to apply to any estimate of benefits or harms for the type of conduct at issue here. For example, one study based on a sample of the U.S. Department of Justice ("DOJ") price fixing indictments for the period 1961–1988 estimates the probability of detection in a given year to be between 13% and 17%.[190] Other estimates put the overall probability of detection of a price-fixing cartel within a range of 10% and 33%, which is consistent with those observed for certain other crimes, such as burglary, automobile theft, and arson.[191]

(104) These probabilities are somewhat higher than one would generally expect for the types of civil causes of action at issue in this case, given the challenges enforcement agencies often face; and an enforcement agency likely faces a considerably higher threshold for bringing an enforcement action

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188 *See* Section VI.D for details.

189 Actionable conduct will be profitable, even if a party is found to have violated a particular statute, if it is not exposed to penalties or other financial remedies for that conduct. Absent more, injunctive relief, for example, still leaves the offending party with financial gains from its past misconduct. Thus, the relevant probability in deriving a deterrent penalty is the *ex ante* (joint) probability of detection, enforcement, and penalty payment.

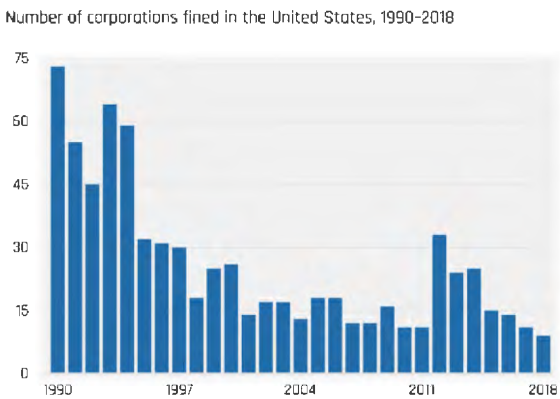
190 Peter Bryant and E. Woodrow Eckart, "Price Fixing: The Probability of Getting Caught," *Review of Economics and Statistics* 73, no. 3 (August 1991): 531–540.

191 Gregory Werden and Marilyn Simon, "Why Price Fixers Should Go To Prison," *Antitrust Bulletin* 32, no. 4 (Winter 1997): 917–937. Based on a sample of cartel convicted by the European Union between 1969 and 2007, a study estimated the probability of detection to be between 12.9% and 13.2%. *See* Emmanuel Combe, Constance Monnier, and Renaud Legal, "Cartels: the Probability of Getting Caught in the European Union" (Bruges European Economic Research Papers, paper no. 12, March 2008). For detection probabilities in other crimes, see A. Mitchell Polinsky and Steven Shavell, "The Economic Theory of Public Enforcement of Law," *Journal of Economic Literature* 38 (March 2000): 45–76, footnote 77.

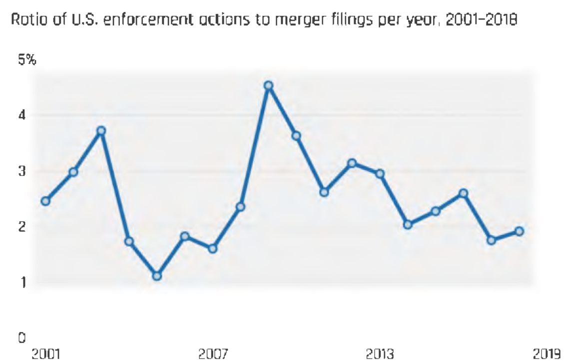
for a civil, rather than a criminal violation. For instance, the U.S. Federal Drug Administration ("FDA") monitors for violations of federal tobacco laws and regulations and works with multiple government entities for compliance and enforcement activities. However, limited resources create challenges for the FDA in accomplishing these tasks.[192] Similarly, the U.S. Securities and Exchange Commission ("SEC") monitors possible violations of securities law and brings enforcement actions in several areas, such as conflict of interest disclosures by investment advisors and broker-dealers and fraudulent securities offerings. However, challenges of funding and unfilled vacancies, among other issues, hinder effective and timely detection and enforcement for that agency as well.[193]

(105) Antitrust enforcement has also declined over the years. A 2019 study notes that fewer companies have been fined for antitrust violations, and the ratio of enforcement actions to merger filings has declined since 2009 (see Figure 12 below). Diminished enforcement is in line with fewer personnel and limited budgets for the U.S. DOJ and the U.S. Federal Trade Commission ("FTC").[194]

Figure 12: Antitrust en orcement actions (le t) and Merger en orcement rates



Source: "Department of Justice Antitrust Division Operations," available at https://www.justice.gov/atr/division-operations [last accessed July 22, 2019]



Source: Federal Trade Commission and U.S. Department of Justice Antitrust Division, "Hart-Scott-Rodino Reports, fiscal years 2001 2018" (n.d.), available at https://www.ftc.gov/policy/reports/policy-reports/annual-competition-reports [last accessed September 20, 2019]; "Federal Trade Commission Competition Enforcement Database," available at https://www.ftc.gov/competition enforcement database [last accessed July 22, 2019].

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[192] "Combatting the Youth Vaping Epidemic by Enhancing Enforcement Against Illegal E-cigarettes," Testimony of Brian A. King before the Committee on the Judiciary, United States Senate, June 12, 2024 ("we also face several challenges such as the size and complexity of the tobacco product landscape and resources that have been flat for the last five years" p. 6) available at https://www.fda.gov/media/179312/download?attachment.

[193] The Inspector General's Statement on the SEC's Management and Performance Challenges, U.S. Securities and Exchange Commission, 2023, available at https://www.sec.gov/files/inspector-generals-statement-sec-mgmt-and-perf-challenges-october-2023.pdf (it notes, "the number of TCRs [tips, complaints, and referrals] received continues to increase, which may stress the agency's capabilities," p. 5; "OWB [Office of the Whistleblower] was experiencing a significant backlog in processing whistleblower claims, which increased the amount of time whistleblowers waited before receiving the Commission's Final Order," p. 6; "the SEC faces challenges in recruiting and retaining highly skilled staff," p. 7).

[194] Filippo Lancieri, Eric Posner, and Luigi Zingales, "The Political Economy of the Decline of Antitrust Enforcement in the United States," *Antitrust Law Journal* 85, no.2 (2023): 449 ("the staff of the Federal Trade Commission has dropped by around 40% since a peak in the late 1970s. U.S. GDP grew approximately 40% since 2010, but the budget of the FTC and the DOJ Antitrust Division has remained roughly constant").

Source: Michael Kades, "The State of U.S. Federal Antitrust Enforcement," *Washington Center for Equitable Growth* (September 17, 2019), Figure 2 and Figure 7, respectively (https://equitablegrowth.org/research-paper/the-state-of-u-s-federal-antitrust-enforcement/).

(106) Antitrust enforcement is a challenge for the states, too. According to a 2020 survey of antitrust attorneys employed by state Attorneys General, most states have limited resources devoted to antitrust, with 27 states having fewer than three full-time attorneys working on antitrust enforcement.[195]

(107) A 33% probability of detection, i.e., the application of three-fold multiplier to an estimate of Google's expected benefits from the conduct at issue, would be generally consistent with the automatic trebling under the antitrust laws (and certain other federal and state statutes),[196] which, at least in part, likely reflects that deterrence was part of the statutory construct. Some scholars, however, have concluded that automatic trebling under the federal antitrust statutes does not adequately account for the probability of deterrence (i.e., that the multiplier should be higher), as it does not account for various other factors not included in antitrust damage awards.[197] Additional support for the conclusion that the automatic trebling under the antitrust laws is insufficient for deterrence, and thus that the probability of detection is likely less than 33%, is the fact that while mandatory treble damages have been in place since the Sherman Act was enacted, all types of antitrust violations have continued to occur with some regularity since then, even as the number of enforcement actions has fallen in recent years (as seen in Figure above). Further evidence of the insufficiency of treble damages in deterring anticompetitive conduct is the sharp increase in the number of detected price-fixing cartels after many enforcement agencies, including the U.S. DOJ, adopted leniency programs to encourage participants in such cartels to come forward voluntarily and cooperate with enforcers in return for some measure of leniency.[198] The large number and percentage of cartels that were detected only after such leniency programs were implemented indicates the relatively low

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195 Thurman Arnold Project, "Modern Antitrust Enforcement," Yale School of Management, available at https://som.yale.edu/centers/thurman-arnold-project-at-yale/modern-antitrust-enforcement.27

196 *See*, e.g., Indiana Code § 24-5-0.5-4 (2023), which states that the court "may increase damages for a willful deceptive act in an amount that does not exceed the greater of: (1) three (3) times the actual damages of the consumer suffering the loss; or (2) one thousand dollars ($1000)," in an action brought by "a person relying upon an uncured or incurable deceptive act;" Nevada Rev State § 598.0971 (2023), which permits the imposition of "an administrative fine of $1,000 or treble the amount of restitution ordered, whichever is greater;" North Dakota Century Code § 51-15-09 (2023), which states that "if the court finds the defendant knowingly committed the conduct, the court may order that the person commencing the action recover up to three times the actual damages proven;" South Carolina Code § 39-5-50 (2023), which states that the court "shall award three times the actual damages sustained" in an action brought "individually" by "any person who suffers any ascertainable loss of money or property… as a result of the use… of an unfair or deceptive method;" and Texas Code § 17.50 (2023), which similarly provides for treble damages for "mental anguish." *See also* 15 U.S.C. § 15 (2023) and 18 U.S.C. (1964) for examples of federal laws allowing for treble damages.

197 *See* Robert H. Lande, "Are Antitrust "Treble" Damages Really Single Damages," 54 Ohio St. L.J. 115 (1993).

198 *See* Joan-Ramon Borell, Carmen García, Juan Luis Jiménez, and José Manuel Ordoñez-De-Haro, "25 Years of Leniency Programs: A Turning Point in Cartel Prosecution," *CPI Antitrust Chronicle*, January 2019, pp. 6-8.

probability of detecting anticompetitive conduct in the absence of such programs; and there are no comparable leniency programs that address the type of single-firm conduct at issue in this case.

(108) Based on the above considerations, and consistent with the literature cited above, I consider it reasonable to use a range of between 10% – 33% for the (joint) *ex ante* probability of detection, enforcement, and penalty payment in evaluating the conduct at issue in this case.

VI.D. The large value of **Google's** estimated benefits results in substantial deterrent penalties

(109) Based on the Google documents discussed above documenting the estimated incremental annual revenues Google was able to earn shortly after the start of the conduct, one can derive the expected total value of those benefits as of the start of the conduct at the end of 2013. I do so by assuming that Google would have reasonably expected those benefits to continue into the future. First, I estimate Google's *ex ante* expected value of the benefits at the time the conduct began, i.e., as of the end of 2013. Second, I calculate an estimate of the *ex post* realized benefits, as if those expected benefits were in fact realized through 2023, using the estimates provided by the documents, but assuming that those estimated benefits grew in line with the actual growth rates in Google's Ad Tech business. Under each approach, I first estimate the expected benefits of the Bernanke program considered alone, using two alternative estimates of incremental profits; and then I aggregate the benefits from that program with additional expected benefits from DRS and RPO. I bring the resulting present value of the benefits to Google forward to June 2025, the earliest date I assume a penalty would be paid.

VI.D.1. Deterrent penalties based on expected *ex ante* value to Google of the Bernanke program alone

(110) I first examine the Bernanke program in isolation. In my analysis, I calculate the present value of the benefits at the end of 2013, and I then bring that value forward in time to June 2025. I assume that the estimated benefits were based on current benefits and that they would have been expected to increase with the growth in Google's revenues. As a result, I perform my calculations using two alternative annual revenue growth rates: 3% and 5%. I choose 3%, as that is consistent with (and indeed, lower than) expectations of GDP growth rates as of 2013;[199] and I choose 5%, as that is what I consider to be a lower bound estimate of the expected growth rates of Google's Ad Tech business

[199] Federal Reserve Board, "SEP: Compilation and Summary of Individual Economic Projections," June 18-19, 2013, 1, https://www.federalreserve.gov/monetarypolicy/files/FOMC20130619SEPcompilation.pdf (showing forecasts of longer run real GDP growth of 2% at low end of range and inflation of 2%, resulting in long-term nominal GDP growth of 4%).

as of 2013, given the prior rapid growth of the company.[200] Indeed, given Google's rapid growth at that time, and the expected continued growth of digital and programmatic advertising, I expect the 3% growth scenario will underestimate significantly Google's expected benefits from the Bernanke program. To convert the estimated future benefits into present value terms as of 2013, I use Google's weighted average cost of capital ("WACC") in 2013 of 9.8%.[201]

(111) Because the Google documents I cite in Section VI.B state the expected benefits in terms of incremental revenues, to measure the net benefits to Google, I convert the estimated benefits to incremental profit. From an economic perspective, the appropriate measure for this calculation is not Google's operating profits, as used by Dr. Wiggins in some of his calculations,[202] but rather its incremental profits associated with the estimated incremental revenues. If there are no additional costs to generating the incremental revenues, the incremental revenues alone may be the appropriate measure of incremental benefits. To derive incremental profits, the question arises as to how to measure those incremental costs, i.e., based on Google's gross margins or its operating margins. I do not expect the incremental revenues generated by the conduct at issue to have generated significant incremental operating expenses, thus I use Google's gross margins from its DVAA segment to estimate a lower bound of its incremental benefits from the conduct.[203] I also assume that the incremental revenues estimated by Google in the relevant documents are gross bookings, not net revenue; this assumption lowers the gross margin number I use in my calculations (relative to the alternative assumption), lowering the resulting estimate of the deterrent penalty.

(112) Figure 13 shows the results of these calculations. Based on Google's documents, as of 2013, the present value of the expected revenues of the Bernanke program would have been in the range of [redacted], while the present value of expected profits would have been in the range of [redacted]n (in 2013 dollar terms). Adjusting the profit amounts by the *ex ante* probability of detection of between 33% and 10% results in deterrent amounts of [redacted] and [redacted] (again in 2013 dollars). The reason for the wide range of these estimates is due in part to the different annual growth assumptions, but mostly to the substantial differences from using a 33% versus a 10% probability of detection (i.e., a multiplier of three versus one of ten). Based on the

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200 By comparison, the compound annual growth rate ("CAGR") of Google's DVAA segment booked revenues was [redacted] between 2013 and 2023. See my backup materials for details.

201 I obtain data on Google's WACC from Bloomberg and use mid-year values, when available. Google's 9.8% WACC is dated to September 30, 2013. This is the earliest value available for 2013. *See* Bloomberg, "GOOGL US Equity," December 31, 2012 to August, 28, 2024.

202 *See, e.g.,* Wiggins Report, Table 2.

203 Alphabet Inc., *Form 10-K 2023,* January 30, 2024, ("Our operating expenses include costs related to R&D, sales and marketing, and general and administrative functions. Certain of our costs and expenses, including those associated with the operation of our technical infrastructure as well as components of our operating expenses, are generally less variable in nature and may not correlate to changes in revenue," p. 32).

discussion above in Section VI.C, I consider the 20% probability (resulting in a multiplier of five) to provide a reasonable mid-point estimate of the appropriate deterrent amount.

Figure 13: Deterrent penalties a sed on present value o incremental ene it as o end-2013 with DVAA gross margin, Bernanke in isolation (2013 dollars)

Scenario	As of 2013				
	Incremental revenue	Incremental profit	Profit-based deterrent penalty, using probability of detection:		
			33%	20%	10%
3% annual growth	[redacted]				
5% annual growth					

Source: Bloomberg, GOOG-DOJ-28385887 at -5895, Andrien Report backup for Exhibit 2 (2013–2021). Skinner Report backup for Table 4B (2022–2023).
Notes: I calculate incremental profit as the product of the incremental annual revenue amount and Google DVAA's gross profit margin in the 2013-2023 period. My calculation of gross profit margin reflects Adsense for Content, AdX, Doubleclick Bid Manager, AdMob, Doubleclick for Publishers, AdServing, Ad Manager, AwBid, Display & Video 360, Campaign Manager, and Google Ads.

(113) The analysis above provides the present value of the expected benefits of the Bernanke program alone to Google in 2013 compared to the present value of the deterrent amount, also in 2013, that would have been necessary to deter that conduct. Since the earliest the penalty would be assessed is in mid-2025 (assuming a finding of liability), I need to convert the 2013 dollar values to 2025 dollars. Here, I bring the penalty amount forward to 2025, using Google's actual WACC for each of the intervening years (and an estimate for 2025). As shown in Figure 14, this results in deterrent penalty amounts of between [redacted] in 2025 dollars, depending on the expected growth rate and probability of detection.

Figure 14: Deterrent penalties a sed on present value o incremental ene it as o June 2025 with DVAA gross margin, Bernanke in isolation (2025 dollars)

Scenario	As of 2025				
	Incremental revenue	Incremental profit	Profit-based deterrent penalty, using probability of detection:		
			33%	20%	10%
3% annual growth	[redacted]				
5% annual growth					

Source: Bloomberg, GOOG-DOJ-28385887 at -5895, Andrien Report backup for Exhibit 2 (2013–2021). Skinner Report backup for Table 4B (2022–2023).
Notes: I calculate incremental profit as the product of the incremental annual revenue amount and Google DVAA's gross profit margin in the 2013-2023 period. My calculation of gross profit margin reflects Adsense for Content, AdX, Doubleclick Bid Manager, AdMob, Doubleclick for Publishers, AdServing, Ad Manager, AwBid, Display & Video 360, Campaign Manager, and Google Ads.

VI.D.2. Deterrent penalties based on expected *ex ante* value of the Bernanke program alone, using forecast margins

(114) While these numbers are substantial, they likely underestimate the expected benefits to Google from the Bernanke program. In the above calculations, I use the DVAA segment gross margins, but the "Beyond Bernanke" presentation shows expected profit margins for the incremental revenues from the Bernanke program that were greater than those for the DVAA segment as a whole.[204] In Figure 15, I use this higher profit margin in place of the DVAA gross margin. This increases the present value of expected profits to between [redacted] in 2013 dollars, and to between [redacted] in June 2025 dollars. Accounting for the probability of detection produces a range of potential deterrent penalties of between [redacted] billion in 2025 dollars.

[204] GOOG-DOJ-28385887 at -5895. The 'RASTA' results present Bernanke attributable revenues as [redacted] and profits as [redacted] over the period the experiment was run. Using these figures, Bernanke's estimated profit margin is [redacted]

Figure 15: Deterrent penalties a sed on present value o incremental pro it with "Beyond Bernanke" pro it margin, Bernanke in isolation (2013 and 2025 dollars)

Category	Scenario	Incremental profit	Profit-based deterrent penalty, using probability of detection: 33%	20%	10%
Incremental Profit as of 2013	3% annual growth	[redacted]			
	5% annual growth				
Incremental Profit as of June 2025	3% annual growth				
	5% annual growth				

Source: Bloomberg, GOOG-DOJ-28385887 at -5895, Andrien Report backup for Exhibit 2 (2013–2021). Skinner Report backup for Table 4B (2022–2023).
Notes: I calculate incremental profit as the product of the incremental annual revenue amount and the profit margin estimate calculated from the "Beyond Bernanke" results presentation. My calculation of gross profit margin reflects Adsense for Content, AdX, Doubleclick Bid Manager, AdMob, Doubleclick for Publishers, AdServing, Ad Manager, AwBid, Display & Video 360, Campaign Manager, and Google Ads.

(115) To provide context for these numbers, recall that Dr. Wiggins claims that he "estimated the incremental profits that Google would have earned due to the alleged deception about RPO, DRS v1, DRS v2, and Bernanke to be $21.7 million."[205] And Dr. Wiggins goes further in arguing that none of the deceptive programs generated incremental profits for Google.[206] Meanwhile, the Google-internal estimate (before the start of this litigation) is that in a single year, the incremental profit that Google earned as a result of the Bernanke program alone is approximately [redacted].[207]

VI.D.3. Deterrent penalties based on expected *ex ante* combined value of Bernanke, DRS, and RPO programs

(116) The above calculations do not take into account the additional expected benefits of the DRS and RPO programs. Accordingly, I further examine the impact on the above calculations of the deterrent penalty amount by incorporating the incremental revenues and profits expected from these programs. In estimating the expected benefits from the three programs collectively, even though the alleged conduct started at different times for the different programs, for ease of presentation, I first

205 Wiggins Report, ¶ 257.

206 Wiggins Report, ¶ 19.

207 Approximately [redacted] in annual revenue at profit rate of around [redacted] implies incremental profits of around [redacted] in a single year.

calculate the present value as of the end of 2013 and then bring the expected benefits forward to June 2025.[208]

(117) Figure 16 shows that the present value of the expected revenues of the DRS, RPO, and Bernanke programs ranges from [redacted] in 2013 dollars and from [redacted] billion in 2025 dollars. The incremental profit figures increase to between $2.9 billion and $4.0 billion in 2013 dollars and between $8.9 and $12.4 billion in 2025 dollars. Accounting for the probability of detection and enforcement increases the deterrent amounts to between $8.7 billion and $40.3 billion in 2013 dollars, and to between $26.7 billion and $124.4 billion in 2025 dollars.

Figure 16: Deterrent penalties a sed on present value o incremental   ene it across Bernanke, DRS, and RPO com i ned (2013 and 2025 dollars, in millions)

Category	Scenario	Incremental revenue	Incremental profit	Profit-based deterrent penalty, using probability of detection:		
				33%	20%	10%
Incremental benefit as of 2013	3% annual growth	[redacted]	$2,888	$8,664	$14,441	$28,881
	5% annual growth	[redacted]	$4,030	$12,091	$20,151	$40,302
Incremental benefit as of June 2025	3% annual growth	[redacted]	$8,916	$26,749	$44,582	$89,163
	5% annual growth	[redacted]	$12,442	$37,327	$62,211	$124,422

Source: Bloomberg, GOOG-DOJ-28385887 at -5895, GOOG-AT-MDL-B-001114919, GOOG-DOJ-32280412 at -0447, Andrien Report backup for Exhibit 2 (2013–2021). Skinner Report backup for Table 4B (2022–2023).
Notes: I calculate incremental profit as the product of each incremental annual revenue amount across the three programs and Google DVAA's gross profit margin in the 2013-2023 period. My calculation of gross profit margin reflects Adsense for Content, AdX, Doubleclick Bid Manager, AdMob, Doubleclick for Publishers, AdServing, Ad Manager, AwBid, Display & Video 360, Campaign Manager, and Google Ads.

(118) My analysis above focuses on the incremental benefits of the Bernanke, DRS, and RPO programs, which constitute a subset of the programs at issue in this matter. For example, my calculations do not consider the benefits Google derived from Dynamic Allocation and Enhanced Dynamic Allocation, which I understand led to higher win rates, and consequently higher revenue, for AdX while conversely lowering the win rates and revenue for non-Google exchanges.[209] The values I present in Figure 16 would likely be larger had I considered the benefits from other Google programs.

[208] The RPO and DRS programs started in 2015 and the Bernanke program in 2013. *See* Andrien Report, ¶ 11.d. I use the 2015 WACC for the present value calculations of benefits from the RPO and DRS programs, and the 2013 WACC for those from the Bernanke program.

[209] Weinberg Report, ¶ 12.a.

VI.D.4. Deterrent penalties if *ex ante* expected benefits limited to 20 years

(119) I have seen no information in the documents to indicate that Google expected the benefits from the programs at issue to be limited in time. Nonetheless, I evaluate the impact on the above calculations, if I were to assume that Google expected the benefits from these programs to only last for 20 years.

(120) For brevity, I examine the impact on the lowest and highest of the above scenarios, i.e.: (i.) the first scenario above, limited to the benefits from Bernanke alone, using the DVAA profit margin, and assuming a 3% annual growth rate; and (ii.) the last scenario, which includes the benefits from the three programs at issue, and using a 5% annual growth rate. The results are shown in Figure 17, with the range of deterrent penalties ranging from [redacted] to $75.9 billion in 2025 dollars.

Figure 17: Deterrent penalties assuming a 20-year e ne it term (2025 dollars, in millions)

Scenario	PV of incremental profit as of 2025	Profit-based deterrent penalty, using probability of detection:		
		33%	20%	10%
Bernanke - 3%	[redacted]	[redacted]	[redacted]	[redacted]
All programs -5%	$7,590	$22,770	$37,950	$75,901

Source: Bloomberg, GOOG-DOJ-28385887 at -5895, GOOG-AT-MDL-B-001114919, GOOG-DOJ-32280412 at -0447, Andrien Report backup for Exhibit 2 (2013–2021). Skinner Report backup for Table 4B (2022–2023).
Notes: I calculate incremental profit as the product of each incremental annual revenue amount across the three programs and Google DVAA's gross profit margin in the 2013-2023 period. My calculation of gross profit margin reflects Adsense for Content, AdX, Doubleclick Bid Manager, AdMob, Doubleclick for Publishers, AdServing, Ad Manager, AwBid, Display & Video 360, Campaign Manager, and Google Ads.

VI.D.5. Estimated *ex post* value to Google of conduct at issue

(121) The calculations above are estimates of what Google would have expected to earn in incremental benefits from the conduct at issue at the inception of the conduct (in late 2013 for Bernanke, and 2015 for the RPO and DRS programs). I now calculate the benefits from the perspective of 2025, as if the initially measured benefits were in fact realized on a going-forward basis, and if those benefits had grown at the actual rate of growth of Google's Ad Tech revenues, instead of using the 3% and 5% expected growth rates in my calculations above. Rather than bring the calculations back to 2013 dollars, here I bring the dollars forward to 2025 values to estimate the value of those past benefits to Google in terms of 2025 dollars. Figure 18 shows the results of these calculations applied to the Bernanke program alone, using the DVAA gross margins to derive the incremental profit calculations. These results show that the present value (as of 2025) of the incremental revenues and profits from the Bernanke program in isolation, assuming actual benefits were similar to expected benefits (scaled to actual revenues), would have been between approximately [redacted]

respectively through 2025, assuming that the incremental revenue resulting with the Bernanke program grew at the same rate as that of Google's DVAA segment.

Figure 18: Present value o incremental e ne it rom Bernanke ($ million, 2025 dollars)[210]

Year	WACC	Gross profit margin	Incremental revenue ($ million)		Incremental profit ($ million)	
			Revenue	PV	Profit	PV
2014	10.2%	[redacted]				
2015	10.4%	[redacted]				
2016	10.7%	[redacted]				
2017	11.3%	[redacted]				
2018	12.1%	[redacted]				
2019	9.4%	[redacted]				
2020	7.6%	[redacted]				
2021	9.4%	[redacted]				
2022	10.6%	[redacted]				
2023	10.9%	[redacted]				
	2014-202 [redacted]					

Source: Bloomberg, GOOG-DOJ-28385887 at -5895, GOOG-AT-MDL-B-001114919, GOOG-DOJ-32280412 at -0447, GOOG-DOJ-28385887 at -5895, GOOG-AT-MDL-B-001114919, GOOG-DOJ-32280412 at -0447, Andrien Report backup for Exhibit 2 (2013–2021). Skinner Report backup for Table 4B (2022–2023).
Notes: I calculate incremental profit as the product of each incremental annual revenue amount and Google DVAA's gross profit margin in that year. My calculation of gross profit margin reflects Adsense for Content, AdX, Doubleclick Bid Manager, AdMob, Doubleclick for Publishers, AdServing, Ad Manager, AwBid, Display & Video 360, Campaign Manager, and Google Ads. Present Value of profit in year t is calculated as $NominalProfit_t \times (1 + WACC_t)^{0.5} \times (1 + WACC_{t+1}) \times \ldots \times (1 + WACC_{2024}) \times (1 + WACC_{2024})^{0.5}$.

(122) As above, I also perform these same calculations using the profit margins from the "Beyond Bernanke" presentation, which exceeds the DVAA gross margins. Substituting the DVAA gross margin with the Bernanke program margin increases the present value of incremental profits from [redacted].[211] I further evaluate the impact on these calculations of including the total estimated benefits from the combined DRS, RPO, and Bernanke programs, using

[210] As the "Beyond Bernanke" presentation is dated to August 2015, I assume that the incremental revenue in 2014 would be half of the [redacted] amount to account for potentially lower benefits during the start-up phase of the program. *See* GOOG-DOJ-28385887.

[211] Calculation details are included in my backup materials.

the DVAA gross margin. Combining the results for all three programs increases the present value of the incremental profits to $4.4 billion.[212]

(123) Lastly, in Figure 19, I apply the probability of detection to derive the deterrent penalty amounts based on the incremental profits. This results in deterrent penalty amounts that range between [redacted] and $43.7 billion. Again, a reasonable fact finder could determine that the appropriate penalty is within this range or, potentially, even higher.

Figure 19: Deterrent penalties a sed on present value o *realized* incremental e ne it, aggregated across the three programs ($ million, 2025 dollars)

Method	Incremental revenue	Incremental profit	Profit-based deterrent penalty, using probability of detection:		
			33%	20%	10%
Bernanke - DVAA average margin	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Bernanke - "Beyond Bernanke" margin	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
All programs combined - DVAA average margin	[redacted]	$4,374	$13,121	$21,868	$43,736

Source: Bloomberg, GOOG-DOJ-28385887 at -5895, GOOG-AT-MDL-B-001114919, GOOG-DOJ-32280412 at -0447, Andrien Report backup for Exhibit 2 (2013–2021). Skinner Report backup for Table 4B (2022–2023).
Notes: I calculate incremental profit as the product of the combined incremental annual revenue amount across the three programs and Google DVAA's gross profit margin in that year. My calculation of gross profit margin reflects Adsense for Content, AdX, Doubleclick Bid Manager, AdMob, Doubleclick for Publishers, AdServing, Ad Manager, AwBid, Display & Video 360, Campaign Manager, and Google Ads. Present Value of profit in year t is calculated as $NominalProfit_t \times (1+WACC_t)^{0.5} \times (1+WACC_{t+1}) \times \ldots \times (1+WACC_{2024}) \times (1+WACC_{2024})^{0.5}$.

VI.D.6. Penalty amounts if based only on Google's benefits in Plaintiff States

(124) As discussed above, for a penalty to have a deterrent effect in the Plaintiff States, it must be based in part on the total expected benefits (or social costs) of the conduct at issue, not based on a limited fraction of those expected benefits (or social costs). This is the reason why, in my calculations above, I use Google's total estimated incremental revenues and profits resulting from the conduct at issue, not a portion of those revenues and profits allocated to the Plaintiff States. If it were based on the latter, even after dividing by the probability of detection, enforcement, and penalty collection, the expected benefits to Google from engaging in the conduct would exceed its costs, and thus the penalty assessed by the Plaintiff States would be insufficient to deter this or similar future conduct in the Plaintiff States, either by Google or similarly situated parties. This is particularly the case here, given that the conduct at issue involves algorithms and programs that are deployed in Google's Ad

212 Calculation details are included in my backup materials.

Tech products used in digital advertising auctions globally; and Google's other conduct at issue described in the complaint and the other expert reports, or the way in which it collects and uses information to disadvantage competitors and benefit its own business, is similarly global in nature. Additionally, even if Google ceased the conduct at issue and no longer directly accrues any associated incremental benefits, Google would still receive benefits from its past conduct into the future: to the extent that Google's deceptive conduct had an impact on competition in the Ad Tech industry,[213] e.g., contributing to the market exit of competitors or deterring potential market entrants, then Google's conduct will continue to yield benefits even after the cessation of the conduct. The appropriate penalty amount must therefore be higher to account for this. I further note that none of the penalty amounts I derive above exceed the Plaintiff States' statutory limits on the per violation penalty amount. For example, dividing the largest deterrent penalty amount calculated above, $124.4 billion (see Figure 16), by even Dr. Wiggins's (under)estimate of the number of statutory violations (579 billion) results in a per violation penalty of $0.21 per violation – far below the statutory maximum per violation specified in the relevant Plaintiff State statutes. Applying this $124.4 billion deterrent penalty amount to the higher counts of violations I discuss above would simply reduce the per violation penalty even further.

(125) Nonetheless, here I demonstrate the impact on my calculations above, if the jury or the court were to determine that only a portion of my estimates of the total deterrent penalty amount should be allocated to the Plaintiff States, e.g., based on either the fraction of Google's global conduct at issue occurring in the Plaintiff States, or based on the fraction of Google's revenues (either in total or in its Ad Tech business) associated with the Plaintiff States at issue. To do so, for the sake of simplicity, I use the portion of Google's Ad Tech total booked revenues allocated to the Plaintiff States by Mr. Andrien in his report and replicated above, [redacted] (see Figure 8), as a percentage of its total Ad Tech booked revenues, [redacted] (see Figure 5), or 13.7%. In doing so, however, it is important to note that this will necessarily underestimate, and likely substantially underestimate, that portion of Google's Ad Tech revenues that are related to the Plaintiff States, either via the affected publishers, advertisers, consumers, or Google infrastructure located in those states, as discussed above with regard to the allocation of affected revenue and transactions. With that important caveat in mind, even if such an allocation were required, and even if one were to use an allocation of 13.7% rather than a higher percentage, my deterrent penalty calculations above would still produce penalties of as much as $17.0 billion (in 2025 dollar terms), e.g., multiplying 13.7% by the deterrent penalty amount of $124.4 billion derived in Figure 16 (based on the expected benefits from Bernanke, DRS, and RPO, using an expected 5% annual growth rate, and accounting for a 10% probability of detection, enforcement, and penalty collection).[214]

[213] See Section III.C, above.

[214] I calculate the impact of such an allocation on my other deterrent penalty calculations in my backup materials.

(126) It is important to emphasize several points about any such allocation procedure, particularly as applied to the deterrent penalty amounts I derive above. First, given the estimates of the benefits of the conduct from Google's documents, the range of allocated penalties would no longer represent deterrent penalties, as articulated in the economic and finance literature referenced above; they represent significantly less than deterrent penalties and would not be sufficient to deter the conduct at issue in the Plaintiff States. Second, it is my understanding that neither the federal government nor the other non-plaintiff states are seeking to recover penalties; it is my understanding that the federal government does not have the statutory authority to do so. Nor is it my understanding that other jurisdictions outside the U.S. are seeking to recover penalties for the identical conduct at issue in this case. Thus, imposing on Google only a portion of the deterrent penalties I calculate above in Section VI.D.1 – Section VI.D.5 will substantially reduce, and potentially eliminate entirely, their deterrent effect. Third, such an allocation would significantly understate the likely benefits Google obtained within the Plaintiff States, not only because of the inherent downward bias in the 13.7% allocation factor noted above, but also because my calculations above are derived only from the incremental benefits to Google from the Bernanke, DRS, and RPO programs, not the additional benefits that Google likely obtained from Google's broader conduct at issue. Fourth, such an allocation would not reflect the amount of societal harm caused by the conduct in the Plaintiff States, which is likely much greater than Google's benefits, as discussed above. Fifth, it is my understanding that the jury may consider additional factors, in addition to deterrence, that may support penalties above the amounts that would otherwise result from applying an allocation percentage. Sixth, and finally, as discussed further in the following section, my analysis using an entirely different methodology for deriving deterrent penalties, i.e., one that does not rely on the estimated total benefits to Google from the conduct, indicates that penalties of between $12 billion and $25 billion, and likely higher, are necessary to have a deterrent effect on future conduct in the Plaintiff States by Google, and by similarly situated parties.

VII. **Google's** prior penalties provide an alternative method to estimate deterrent penalties

(127) In his report, Dr. Wiggins considers certain prior enforcement actions against Google, and certain fines and settlements paid by Google, but he concludes, "contrary to Mr. Andrien's claims, Google does not have a history of engaging in conduct similar to the deception alleged in this case."[215] I disagree with Dr. Wiggins's characterization of many of these proceedings as being either too far removed from the conduct at issue or from geographies too far remote (i.e., outside the U.S.) to be relevant, whether in the context of Mr. Andrien's analysis or in the context of factor (2) under the

[215] Wiggins Report, ¶ 273.

Texas DTPA, for example.[216] My primary disagreement with Dr. Wiggins, however, is conceptual: Google's history of prior enforcement actions and prior penalties and settlements are highly relevant for assessing the penalty amount that would be necessary to deter Google or others from engaging in similar actions in the future. This is because these prior fines and settlements, even if they were for conduct entirely unrelated to the conduct at issue here, provide a way of assessing whether they had a sufficiently detectable impact on Google's stock price, such that they likely led, or would have led, to a change of behavior, independent of any explicit conduct remedies in those actions. In the language of statistics, these prior enforcement actions against Google provide a series of "natural experiments" with which to assess the amount of a penalty that is likely necessary to result in a change in Google's future conduct, particularly when that conduct is otherwise highly profitable (as is the case here). I analyze this further in the remainder of this section.

(128) In the context of the principal-agent problem discussed in Section II.C, above, in which the current actions of managers (agents) may not align with the long-term interests of the shareholders (principals), an examination of Google's history with fines and settlements becomes particularly relevant. Historical penalties can be viewed as empirical tests that shed light on whether such financial punishments are substantial enough to influence corporate behavior, aligning it more closely with shareholder interests. If past penalties did lead to a substantial drop in Google's stock price, they might have incentivized shareholders to demand tighter controls and oversight over managerial decisions, thereby addressing the principal-agent problem with regard to the type of conduct at issue here. This potential alignment mechanism supports the need for a deterrent penalty that not only addresses the immediate misconduct but also serves to realign the interests of management with those of shareholders, ensuring that management does not engage in subsequent misconduct at the expense of long-term shareholder value. Thus, analyzing the impact of these penalties in the context of the principal-agent problem provides a valuable lens through which to assess the penalty amounts that are large enough to enforce corporate compliance and deter future misconduct.

VII.A. Previous enforcement actions show that large penalties are required to deter **Google's** conduct at issue

(129) Numerous U.S. federal, state, and international regulatory and enforcement agencies have brought actions against Google for alleged violations of various statutes between 2011 and the present, resulting in Google paying billions of dollars in fines and settlements.[217] These actions against Google, which have originated across the world but have been concentrated in the EU and the U.S.,

[216] Texas Deceptive Trade Practices Act § 17.47(g)(2), ("(2) the history of previous violations").

[217] *See* Wiggins Report, Table 6.

have included allegations of violations related to antitrust, consumer privacy, and Ad Tech issues. In the EU, notable cases include the following:

- On November 30, 2010, the European Commission opened an antitrust investigation into allegations that Google has abused a dominant position in online search.[218] Subsequently, between 2017 and 2019, the European Commission imposed three fines on Google, amounting to a total of $9.5 billion.
  - In 2017, Google was fined $2.74 billion for illegally directing search results to Google Shopping, its own comparison shopping service.[219] Google appealed the decision to the EU General Court later in 2017, but the appeal was rejected on November 10, 2021.[220]
  - In 2018, Google was fined $5.1 billion for illegally using its Android mobile operating system to impose restrictions on Android device manufacturers that served to funnel users toward the Google search engine.[221] Google's appeal of the decision was rejected by the EU General Court in 2022.[222]
  - In 2019, Google was fined $1.69 billion for imposing exclusive contracts on publishers, which prohibited publishers from placing search results from rivals such as Microsoft and Yahoo on their websites.[223] Google appealed the ruling later in 2019, and the appeal is still pending a decision.[224]

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218 European Commission, "Antitrust: Commission probes allegations of antitrust violations by Google," news release no. IP/10/1624, November 30, 2010, https://ec.europa.eu/commission/presscorner/detail/en/IP_10_1624.

219 Kelvin Chan, "Google loses appeal of huge EU fine over shopping searches," *Associated Press*, November 21, 2021, https://apnews.com/article/business-european-union-european-commission-europe-euro-b7baf101cacca2f1a6d21faba5a7b91e. *See also* "German price platform sues Google over search results," *Associated Press*, April 12, 2019, https://apnews.com/international-news-general-news-744586e7278645bba829e81adf8ad9a6.

220 Alphabet Inc., *Form 10-K 2023,* January 30, 2024, 78. *See also* "Antitrust: Commission fines Google €2.42 billion for abusing dominance as search engine by giving illegal advantage to own comparison shopping service," European Commission, June 27, 2017, https://ec.europa.eu/commission/presscorner/detail/en/IP_17_1784. Google's appeal to the European Court of Justice is pending decision as of the filing of this report.

221 The European Commission announced this specific investigation on April 15, 2015, which appears to be a continuation of the 2010 investigation. *See* European Commission, "Antitrust: Commission sends Statement of Objections to Google on comparison shopping service; opens separate formal investigation on Android," news release no. IP/15/4780, April 15, 2015, https://ec.europa.eu/commission/presscorner/detail/en/IP_15_4780. The original fine announced in 2018 was €4.34 billion (worth $5.1 billion in 2018), which then reduced to €4.125 billion (worth $4.13 billion) in 2022. Adam Satariano, "E.U. Scores Major Legal Victory Against Google," *New York Times*, September 14, 2022, https://www.nytimes.com/2022/09/14/business/eu-google-antitrust-fine.html.

222 Google subsequently filed an appeal with the European Court of Justice. This appeal is pending decision as of the filing of this report. *See Form 10-K 2023,* January 30, 2024, 78.

223 David Reid, "EU regulators hit Google with $1.7 billion fine for blocking ad rivals," *CNBC*, March 20, 2019, https://www.cnbc.com/2019/03/20/eu-vestager-hits-google-with-fine-for.html.

224 Alphabet Inc., *Form 10-K 2023,* January 30, 2024, 76.

- In 2023, after a two-year investigation of Google's Ad Tech business, the European Commission issued a "Statement of Objections," with a preliminary finding that Google has breached EU antitrust rules with its Ad Tech business, and with an additional preliminary finding that "only the mandatory divestment by Google of part of its services" would address its competition concerns.[225]

(130) In the U.S., notable prior enforcement actions against Google include the following:

- In 2011, Google agreed to forfeit $500 million of revenue it had obtained by allowing Canadian pharmacies to advertise prescription drugs to U.S. consumers through its AdWords program.[226]
- In 2020, the U.S. DOJ and several states filed a complaint against Google, alleging that Google monopolized the markets for search and search advertising in the U.S.[227] On August 5, 2024, Federal Judge Amit P. Mehta ruled against Google, stating in his opinion that "Google is a monopolist."[228]
- In 2022, Google agreed to pay $391.5 million to a 40-state coalition for continuing to collect user geolocation data after users had disabled location tracking.[229]
- In 2023, the U.S. DOJ filed a complaint against Google, alleging that Google monopolizes key elements of the Ad Tech stack.[230]

(131) Dr. Wiggins's Table 6 shows that Google has paid almost $17 billion in settlements and fines across fifty distinct enforcement actions from 2011 through 2024.[231] As noted above, Dr. Wiggins opines

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225 Alex Hern and Lisa O'Carroll, "EU regulator orders Google to sell part of ad-tech business," *The Guardian,* June 14, 2023, https://www.theguardian.com/technology/2023/jun/14/eu-regulator-google-sell-ad-tech-business-competition-commission. *See also* European Commission, "Antitrust: Commission sends Statement of Objections to Google over abusive practices in online advertising technology," news release, June 14, 2023, https://ec.europa.eu/commission/presscorner/detail/en/IP_23_3207.

226 U.S. Department of Justice, "Google Forfeits $500 Million Generated by Online Ads & Prescription Drug Sales by Canadian Online Pharmacies," news release no. 11-1078, August 24, 2011, https://www.justice.gov/opa/pr/google-forfeits-500-million-generated-online-ads-prescription-drug-sales-canadian-online.

227 U.S. Department of Justice, "Justice Department Sues Monopolist Google For Violating Antitrust Laws," news release no. 20-1124, October 20, 2020, https://www.justice.gov/opa/pr/justice-department-sues-monopolist-google-violating-antitrust-laws.

228 Brian Fung and Clare Duffy, "Google has an illegal monopoly on search, judge rules. Here's what's next," *CNN*, August 6, 2024, https://www.cnn.com/2024/08/05/business/google-loses-antitrust-lawsuit-doj/index.html.

229 Cecilia King, "Google Agrees to $392 Million Privacy Settlement With 40 States," *New York Times*, November 14, 2022, https://www.nytimes.com/2022/11/14/technology/google-privacy-settlement.html.

230 U.S. Department of Justice, "Justice Department Sues Google for Monopolizing Digital Advertising Technologies," news release no. 23-84, January 24, 2023, https://www.justice.gov/opa/pr/justice-department-sues-google-monopolizing-digital-advertising-technologies.

231 *See* Wiggins Report, Table 6 and Table G1. Dr. Wiggins's Table 6 and Table G1 include a $5 billion payment that was attributable to injunctive relief. *See* Wiggins Report, footnote 516.

that Google's history of fines and settlements is not relevant to this matter.[232] Additionally, Dr. Skinner argues Mr. Andrien's proposed penalty range could have "adverse consequences" on Google's "shareholders, business, competitive position, and ability to innovate,"[233] and Dr. Wiggins similarly claims that fines and settlements are "detrimental" to Google.[234] I disagree with both Dr. Wiggins and Dr. Skinner.

(132) The EU settlements in particular illustrate the opposite of what Dr. Wiggins and Dr. Skinner contend: namely, those settlements show that Google has the capacity to absorb large penalties, in the billions of dollars, without experiencing financial difficulties. This is evidenced by the fact that Google has recognized initial charges of over $9.5 billion related to the EU settlements on Google's dominant position in online search, which is above the lower bound of Mr. Andrien's penalty range, while remaining highly profitable, and in fact, becoming significantly more profitable and with its stock price continuing to rise considerably (its current stock price is more than 349% higher than it was in 2017 when the first of the large EU fines was assessed).[235]

(133) The necessity of a substantial penalty amount is corroborated by other enforcement actions in which smaller penalties have failed to deter misconduct by similarly large and highly profitable companies. For example, on August 24, 2021, the Netherlands Authority for Consumers and Markets ("ACM") imposed a weekly fine of €5 million on Apple for forcing dating-app developers to use Apple's own payments service, disallowing the use of third-party services.[236] Rather than cease the conduct at issue, however, Apple instead continued to violate Dutch policy and was fined each week until the accrued fine grew to be €50 million, the maximum fine stipulated by the ACM.[237] Because Apple continued the conduct at issue even as the fines were accumulating, the value of the conduct to Apple appears to have been substantially greater than the €50 million fine, rendering the latter entirely insufficient as a deterrent. Apple's total fine at issue in that proceeding, which had no impact on Apple's conduct, was nearly three times higher than Dr. Wiggins's proposed $22 million lower bound penalty for Google in this matter.

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232 Wiggins Report, ¶¶ 274-278.

233 Skinner Report, ¶ 15.

234 Wiggins Report, ¶ 278.

235 Alphabet Inc., *Form 10-K 2023,* January 30, 2024, 34, 76.
On June 27, 2017, the day the first major EU fine was announced, Google's stock price was $47.4 per share. By August 23, 2024, the stock price had increased to $165.6 per share.

236 The Netherlands Authority for Consumers and Markets, *Summary of decision on abuse of dominant position by Apple,* August 24, 2021, 21, https://www.acm.nl/sites/default/files/documents/summary-of-decision-on-abuse-of-dominant-position-by-apple.pdf.

237 *Ibid*; "Dutch regulator rejects Apple's objections to fines," *Reuters*, October 2, 2023, https://www.reuters.com/technology/dutch-regulator-rejects-apples-objections-against-fines-2023-10-02/.

VII.B. Market reactions to **Google's** past penalties indicate that penalties below $12 billion are unlikely to deter similar conduct in the future

(134) As discussed above, the appropriate deterrent penalty should consider the principal-agent problem inherent to publicly traded companies. A small penalty amount would be unlikely to impact Google's share price, thereby offering little incentive for shareholders to monitor and deter misconduct. The penalty amount must therefore be substantial enough to have an adequate impact on the share price in order to incentivize shareholders to actively monitor and deter corporate misconduct.

(135) To analyze the impact of previous investigations and penalties on Google's stock price, I collect information on 48 instances where Google was subjected to a fine or settlement on account of its conduct.[238] These penalties range between $25,000 and over $9.5 billion[239] prior to any subsequent reductions made by courts upon appeal by Google.[240] I identify 18 penalties imposed in the US, 18 imposed in the EU, and 12 imposed in India, South Korea, Russia, Turkey, or Australia. For each of these 48 instances, I identify the date that the penalty was publicly announced. I am also able to

[238] I referred to three main sources: (1) the Wiggins Report and Andrien Report, (2) regulatory agency press releases, and (3) third-party sources, including news articles reporting the event and databases such as the GDPR Enforcement tracker and the Good Jobs First Violation tracker. All sources were cross-checked with at least one other to ensure the accuracy of the information collected on the penalty. *See* CMS, "GDPR Enforcement Tracker," https://www.enforcementtracker.com/. *See also* Good Jobs First, "Violation Tracker," https://violationtracker.goodjobsfirst.org/.

[239] As discussed above, on November 30, 2010, the European Commission opened an antitrust investigation into allegations that Google has abused a dominant position in online search. Subsequently, between 2017 and 2019, the European Commission imposed three fines on Google, amounting to a total of $9.5 billion. Google was fined $2.7 billion on June 27, 2017, for alleged self-preferencing in Google Shopping searches; $5.1 billion on July 18, 2018, for alleged intentions to consolidate dominance in search on Android devices; and $1.7 billion on March 20, 2019, for alleged abuse of dominance in AdSense. I sum these three penalties to approximate the severity of the 2010 investigation, which is $9.5 billion. In addition to the initial announcement in 2010, the European Commission made a separate announcement of the investigation on Google's alleged intention to consolidate dominance in search on Android devices on April 15, 2015. There was a reduction of the $5.1 billion fine to $4.13 billion in 2022. I use the initial penalty in my analysis for all events. *See* European Commission, "Antitrust: Commission probes allegations of antitrust violations by Google," news release no. IP/10/1624, November 30, 2010, https://ec.europa.eu/commission/presscorner/detail/en/IP_10_1624. *See also* European Commission, "Antitrust: Commission fines Google €2.42 billion for abusing dominance as search engine by giving illegal advantage to own comparison shopping service," news release no. IP/17/1784, June 27, 2017, https://ec.europa.eu/commission/presscorner/detail/en/IP_17_1784; *See also* European Commission, "Antitrust: Commission fines Google €1.49 billion for abusive practices in online advertising," news release no. IP/19/1770, March 20, 2019, https://ec.europa.eu/commission/presscorner/detail/en/IP_19_1770; *See also* Satariano, Adam, "E.U. Scores Major Legal Victory Against Google," *New York Times*, September 14, 2022, https://www.nytimes.com/2022/09/14/business/eu-google-antitrust-fine.html.

[240] For Google's prior penalties that I obtained from the Wiggins Report and Andrien Report, I used the penalty size provided by them unless the penalty had previously been announced at a larger size and later reduced by a court upon appeal by Google. In all other cases, I used the official penalty size as reported in press releases or the first news article which I could find reporting on the event. I convert the penalty to U.S. dollar using the exchange rate on the day that the penalty was publicly announced if the original penalty size was in a foreign currency.

identify the date on which the investigation was announced or the complaint was filed for 17 instances.[241] These 65 event days[242] on which the investigation or penalties were initially publicly announced span from April 2, 2008 to March 20, 2024.[243] To get a sense of the magnitude of these penalties, I calculated the standard deviation of Google's daily stock returns for 2008 and 2023, which are 3.5 percent and 1.9 percent, respectively. These two years represent the first and the most recent full years during which I identified an investigation leading to a penalty. The average market capitalization of Google in these two years is $146 billion and $1,510 billion. Thus, the random shocks equivalent to one standard deviation change to Google's stock returns in these two years translate to a change of $5 billion and $29 billion in Google's market capitalization, respectively. As this comparison makes clear, the past penalties imposed on Google have been small compared to the many other factors that affect Google's share price on a daily basis.

(136) For each of these events, I conduct an event study in which I compare Google's stock return, net of the S&P 500 return, for each of the ten trading days before and after each event day, e.g., the public announcement of the investigation or the penalty.[244] Specifically, for each trading day surrounding the event, I calculate the return on Google's stock by determining the percentage change in the closing share price from the previous trading day. To evaluate Google's performance relative to the overall market, I subtract the S&P 500's return from Google's stock return.[245] Additionally, to analyze the volatility of Google's adjusted stock return, I compute the standard deviation of Google's adjusted stock returns on all trading days except the event days included in the analysis.

(137) Figure 20 below presents Google's adjusted stock returns surrounding 48 event dates when penalties were publicly announced, spanning from ten trading days before to ten trading days after each event date. The fluctuations in Google's adjusted stock returns primarily remain within one standard

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241 As discussed above, on November 30, 2010, the European Commission opened an antitrust investigation into allegations that Google has abused a dominant position in online search. On April 15, 2015, the European Commission announced a separate investigation into Google's illegal use of its Android mobile operating system to impose restrictions on Android device manufacturers, effectively funneling users toward the Google search engine, which appears to be a continuation of the 2010 investigation. I combine the Google stock returns on both days in my analysis.

I have not identified the date of the public announcement for some investigations because there was no public announcement until the penalty was publicly declared, or because there is no announcement available in an English-language source. This includes both official translations on the regulatory agency's website and reports from third-party sources.

242 There are 48 event days of announcement of penalty and 17 event days of start of investigation.

243 See my backup materials for details.

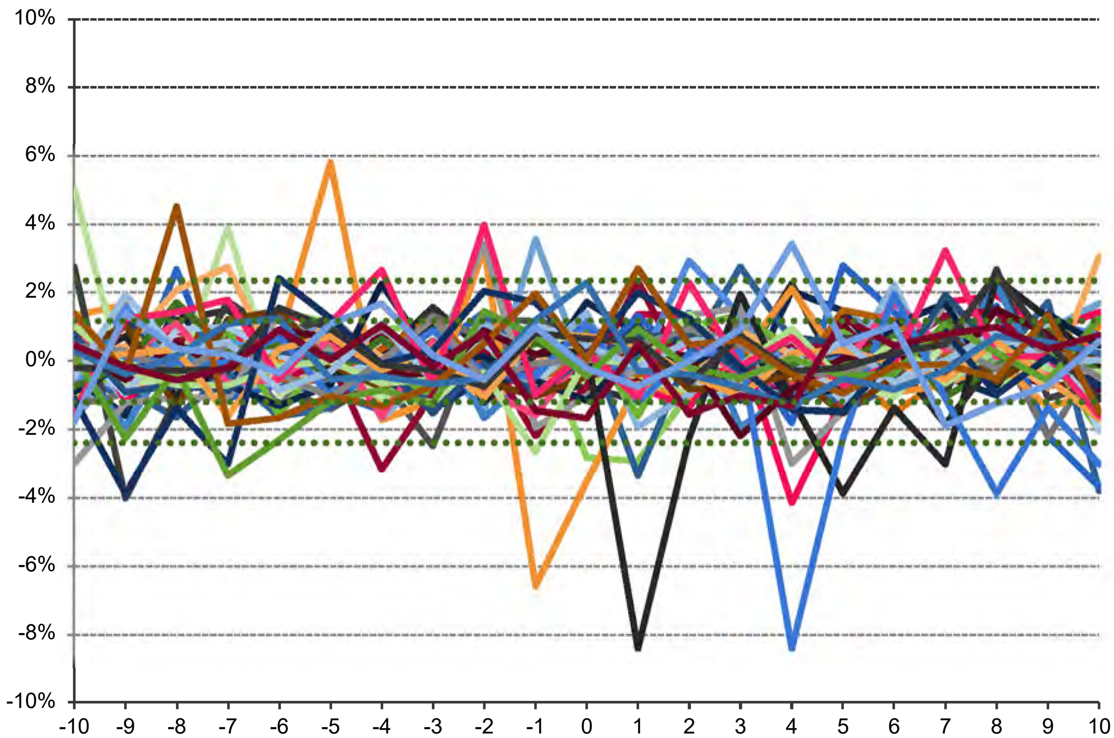
244 When the event day falls on a non-trading day, I adjust the event day to the closest subsequent trading day.

245 The S&P 500 is an index that gauges the performance of the U.S. stock market. It monitors the share prices of the 500 largest publicly traded companies in the U.S. and represents approximately 80% of the total market value of all publicly traded stocks. *See* "What Does the S&P 500 Index Measure and How Is It Calculated?" Investopedia, accessed September 6, 2024, https://www.investopedia.com/ask/answers/040215/what-does-sp-500-index-measure-and-how-it-calculated.asp.

deviation from the average, and are mostly contained within two standard deviations.[246] Also, there is no noticeable change in the volatility of Google's adjusted stock returns before, on, or after the event day. This consistent pattern indicates that the stock returns do not experience additional significant volatility due to the penalties announced on the event days. Therefore, the analysis indicates that these prior penalties have had a minimal impact on Google's stock performance, providing little incentive for shareholders to actively engage in monitoring and deterring corporate misconduct.

[246] The black line indicates a significant decline in Google's adjusted stock return the day following the event day. On October 25, 2022, the event day, Google announced third-quarter earnings that fell short of expectations in terms of both revenue and net income, which likely contributed to the subsequent drop in its stock value. Similarly, the light blue line indicates the same decline four trading days after the event day, which is also one day after October 25, 2022. *See* Capoot, Ashley, "Alphabet just had its worst day since March 2020, when Covid shutdowns started in the U.S.," *CNBC*, October 26, 2022, https://www.cnbc.com/2022/10/26/alphabet-stock-falls-after-disappointing-earnings-report.html. ("Shares of Alphabet closed down more than 9% on Wednesday in the company's worst day since March 2020 after it released third-quarter earnings Tuesday that missed on the top and bottom lines. The company reported its weakest quarter of growth since 2013 except for one other period early in the coronavirus pandemic. Revenue growth slowed to 6% from 41% a year earlier as the company contends with a continued downdraft in online ad spending."). Similarly, the orange line indicates a significant decline in Google's adjusted stock return the day before the event day. On February 8, 2023, the day before the event day, Google's new artificial intelligence technology produced a factual error in its debut demonstration, which likely contributed to the observed drop in Google's stock return on that day and the event day. *See* Olson, Emily, "Google shares drop $100 billion after its new AI chatbot makes a mistake," *NPR*, February 9, 2023, https://www.npr.org/2023/02/09/1155650909/google-chatbot--error-bard-shares. ("Google's parent company, Alphabet, lost $100 billion in market value on Wednesday after its new artificial intelligence technology produced a factual error in its first demo.").

Figure 20: Google stock return net o S&P 500 over ten trading days e ore and a ter each penalty date



Source: Bloomberg.
Note: The green dashed lines represent plus and minus one standard deviation, and plus and minus two standard deviations from the sample mean of adjusted stock returns, calculated using all trading days except for the event days included in this analysis.

(138) Figure 21 below shows Google's stock return, net of the S&P 500 return, for the 48 days when a penalty was publicly announced. The size of each bubble corresponds to the initial penalty's magnitude. This figure indicates no evident correlation between the size of the penalties and their impact on Google's stock returns, which remains relatively consistent over time. The figure also includes one and two standard deviations from the sample average of Google's adjusted stock returns, represented by green horizontal lines. Most of Google's adjusted stock returns on these event days fall within one standard deviation, and all but two are within two standard deviations. One exception occurred on February 9, 2023, as I explained above, which coincides with an incident where Google's new artificial intelligence technology produced a factual error in its debut demonstration one day before the event day.[247] This confounding event likely contributed to the observed drop in Google's stock return on that day. Another exception occurred on April 13, 2012.

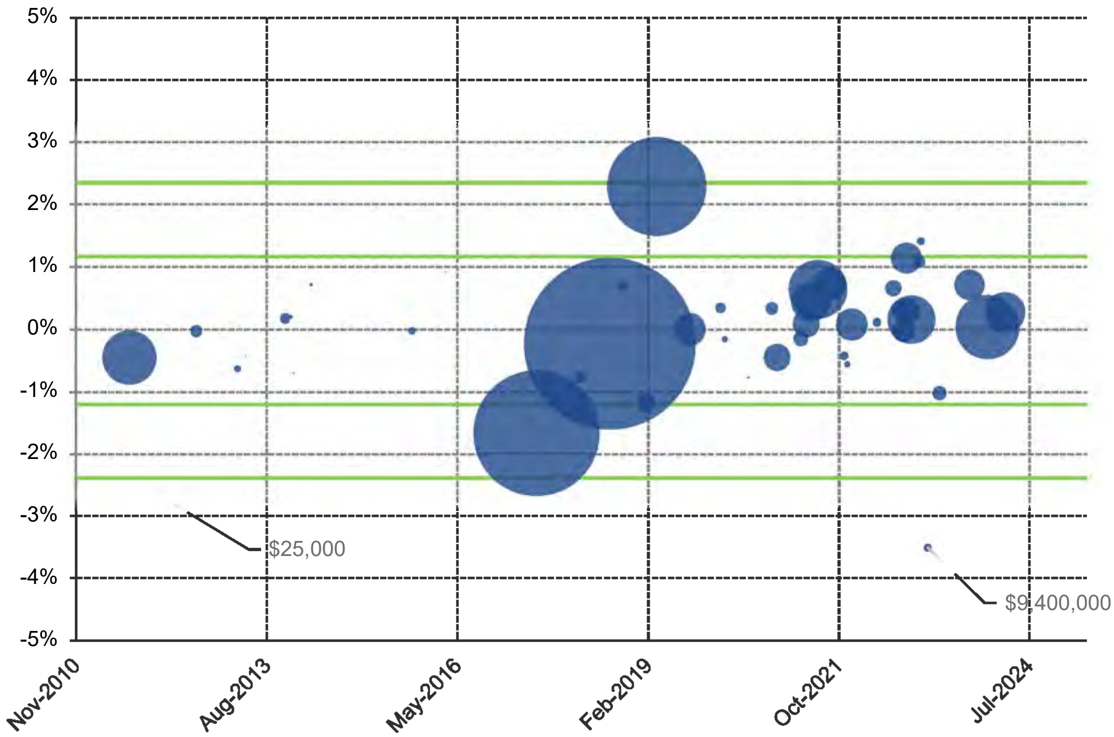
[247] *See* Olson, Emily, "Google shares drop $100 billion after its new AI chatbot makes a mistake," *NPR*, February 9, 2023, https://www.npr.org/2023/02/09/1155650909/google-chatbot--error-bard-shares. ("Google's parent company, Alphabet, lost $100 billion in market value on Wednesday after its new artificial intelligence technology produced a factual error in its first demo.").

One day before that, Google announced a contentious stock split that enabled the company to issue new shares without diluting the voting power of its founders.[248] This move raised concerns among corporate governance watchdogs and frustrated some investors, contributing to the drop.[249] Considering the very small penalty of twenty-five thousand dollars imposed on Google at that time, it is highly unlikely that the penalty itself was the primary cause of the decline. Given that the volatility of Google's adjusted stock returns predominantly fall within the normal range expected from random fluctuations, the figure indicates that these penalties have had a minimal impact on Google's stock performance, providing little incentive for shareholders to actively monitor and deter corporate misconduct.

[248] *See* Richard Davies, "Google's Stock Split Surprise," *ABC News*, April 13, 2012, https://abcnews.go.com/blogs/business/2012/04/googles-stock-split-surprise.

[249] *See* "Google falls on share plan," *Financial Post*, April 13, 2012, https://financialpost.com/news/google-falls-on-share-plan.

Figure 21: Google stock return net o S&P 500 on the penalty days (u l e size corresponds to the amount o penalty)



Source: Bloomberg.
Note: The green lines represent plus and minus one standard deviation, and plus and minus two standard deviations from the sample mean of adjusted stock returns. The standard deviation is calculated based on the adjusted stock returns from ten trading days before and after each event excluding the event days, encompassing all events included in this analysis.

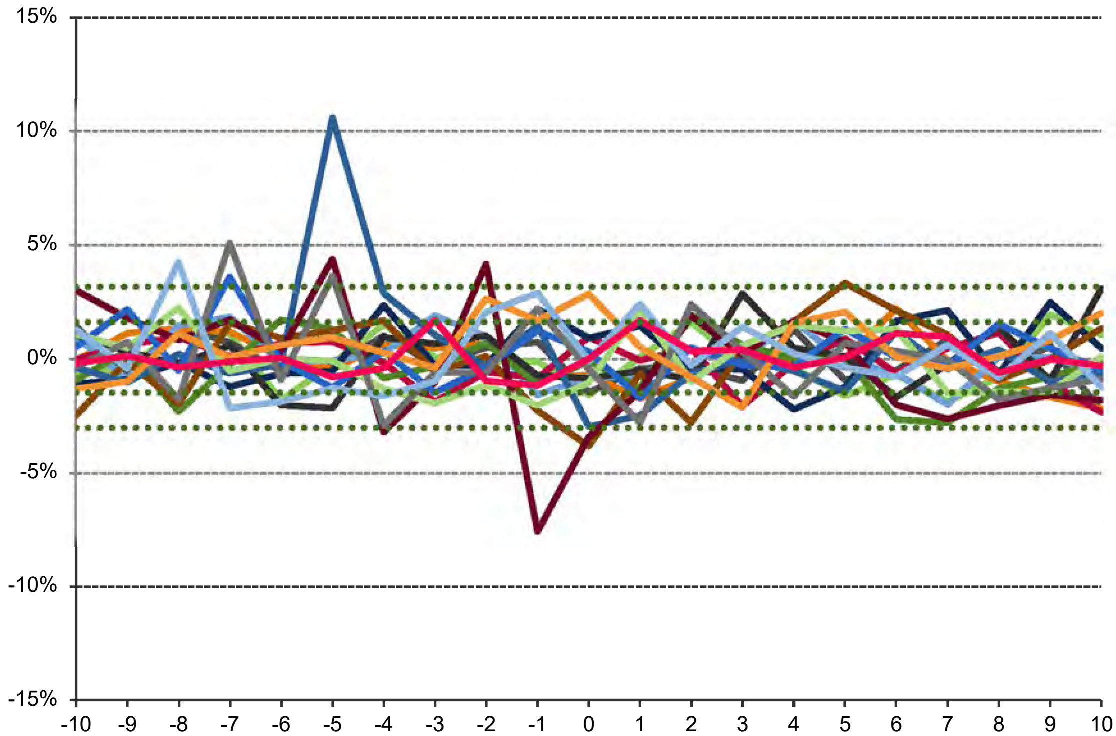
(139) For 17 of these event studies, I was also able to identify the day when the investigation was announced (which ultimately resulted in the penalty). At that point, there may already have been a stock market response, and the full impact may be considered to be equal to the sum of the stock return when the investigation was announced and the stock return when the penalty (and other remedies) were announced. Figure 22, below, replicates the above event analysis, where the relevant event dates are now the combination of the announcements of the investigation and the penalties. Thus, I sum Google's adjusted stock returns on both days for each event.[250] As above, the fluctuations in Google's adjusted stock returns primarily remain within one standard deviation from

[250] As I have explained above, there are five dates associated with the European Commission's investigation of Google Search: (1) the initial start of investigation day on November 30, 2010; (2) the follow-up announcement of investigation into Android operating system on April 15, 2015; and (3) the three dates that penalties were announced publicly on June 27, 2017, July 18, 2018, and March 20, 2019. I combine Google's adjusted stock return on these five days for this event in the analysis.

the average and are mostly contained within two standard deviations.[251] Also, there is no noticeable change in the volatility of Google's adjusted stock returns before, on, or after the event day. This consistent pattern indicates that the stock returns do not experience significant additional volatility due to the penalties announced on the event days.

[251] The dark red line indicates a significant decline in Google's adjusted stock return the day before the event day. As I explained above, on February 8, 2023, the day before the event day, Google's new artificial intelligence technology produced a factual error in its debut demonstration, which likely contributed to the observed drop in Google's stock return on that day and the event day. *See* Olson, Emily, "Google shares drop $100 billion after its new AI chatbot makes a mistake," *NPR*, February 9, 2023, https://www.npr.org/2023/02/09/1155650909/google-chatbot--error-bard-shares. ("Google's parent company, Alphabet, lost $100 billion in market value on Wednesday after its new artificial intelligence technology produced a factual error in its first demo.").

Figure 22: Google com ined stock return net o S&P 500 on oth the start o investigation date and penalty date over ten trading days e ore and a ter the event date or eligi le lawsuits



Source: Bloomberg.
Note: The green dashed lines represent plus and minus one standard deviation, and plus and minus two standard deviations from the sample mean of combined adjusted stock returns, calculated using all trading days except for the event days included in this analysis.

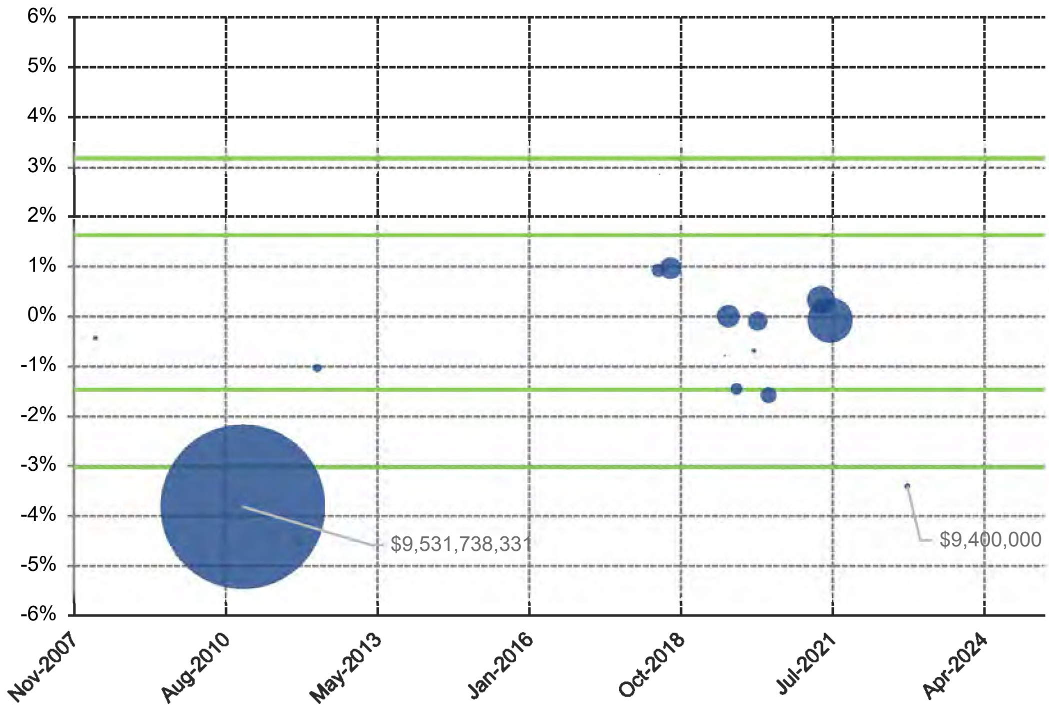
(140) Similarly, I have replicated the bubble chart analysis above with Google's combined adjusted stock returns on the 17 events that include both the start of investigation date and penalty date.[252] Figure 23, below, shows that the combined adjusted stock returns for nearly all events are of modest magnitude, remaining within one standard deviation of typical daily fluctuations. The one noticeable exception is the European Commission's investigation of Google Search announced in late 2010, which led to a total penalty of $9.5 billion. The combined adjusted return of the five associated event dates is -3.8%. In particular, on November 30, 2010—the day the initial investigation into allegations that Google has abused a dominant position in online search was announced—Google's adjusted stock return dropped by 3.9%, marking a highly unusual deviation.[253] Several news articles at the time linked this significant drop to the European Commission's announcement of the

[252] As explained above, I combine Google's adjusted stock returns on the five days associated with the European Commission's investigation into Google search announced in late 2010.

[253] Out of the 504 trading days in 2010 and 2011, there are only three trading days with a lower adjusted return than November 30, 2010. See my backup materials for details.

investigation.[254] The other outlier in the bottom right of the figure is likely due to the factual error made in the debut demonstration of Google's AI product, as discussed above.

Figure 23: Google com ined stock return net o S&P 500 on oth start o investigation date and penalty date (date corresponds to the start o investigation; u l e size corresponds to the amount o penalty)



Source: Bloomberg.
Note: The green lines represent plus and minus one standard deviation, and plus and minus two standard deviations from the sample mean of combined adjusted stock returns. The standard deviation is calculated based on the combined adjusted stock returns from ten trading days before and after each event excluding event days, encompassing all events.

(141) These results indicate that, with the exception of EC investigation that resulted in penalties of $9.5 billion (and associated remedies),[255] none of the other penalties (and associated remedies) were

[254] *See* Pepitone, Julianne, "Stocks end November with a whimper," *CNN Money*, November 30, 2010, https://money.cnn.com/2010/11/30/markets/markets_newyork/index.htm. ("Google's (GOOG, Fortune 500) stock ended down more than 4.5% after the European Commission said it will investigate whether the Internet search company violated antitrust rules."). *See also* Jordans, Frank, "Tagged in a photo without consent? Europe watchdogs take up fight; regulators' probes set the stage for battle with Facebook, Google over protecting users' rights." *Mercury News*, March 25, 2010, https://www.mercurynews.com/2010/11/30/european-authorities-investigating-whether-google-gave-its-services-search-preference/. *See also* "EU sets up antitrust probe of how Google works," *Pioneer Press*, November 12, 2015, https://www.twincities.com/2010/11/30/eu-sets-up-antitrust-probe-of-how-google-works/.

[255] For example, the European Commission has placed injunctions against illegal restrictions on Android device manufacturers and mobile operators. It has also placed injunctions against self-preferencing own comparison shopping service in search results. *See* European Commission, "Antitrust: Commission fines Google €4.34 billion for abuse of dominance regarding Android devices," news release, July 18, 2018, https://ec.europa.eu/commission/presscorner/detail/en/IP_18_4581.

large enough to impact Google's stock market prices more so than any of the other multitude of factors that lead to the daily fluctuations in Google's share price. The conclusion I draw is not that there are no stock market responses to these penalties (and associated remedies), but rather that if there are such responses, they are so small that they are indistinguishable from all the other factors that result in movements in Google's share price and thus unlikely to induce shareholders to force managers to change their future conduct. When the European Commission first announced the investigation, it introduced significant uncertainty into the market regarding Google's future operations in Europe. Investors, concerned about potential fines, restrictions, and the impact on Google's European business, may have reacted negatively, leading to a drop in stock price. By the time the European Commission announced the actual penalty, the market may have already priced in the anticipated outcomes of the investigation. This means investors had enough time to evaluate the potential risks and adjust their positions accordingly. As a result, the actual penalty announcement may not have had a significant additional impact simply because the expected information was already reflected in the stock price. Thus, the size of the total penalties is a reasonable proxy of the severity of the investigation when it was initially announced.

(142) Considering that the penalties were imposed in 2017, 2018, and 2019, and given the significant increase in Google's market capitalization since then, I have calculated the equivalent total penalty that could have a similar impact on Google's stock return as the initial announcement of the investigation by the European Commission in late 2010 for 2025 using various methods.

(143) First, I compute the inflation-adjusted penalty imposed by the European Commission by using the projected inflation rates for each year from when the penalty was announced until June 2025, the earliest date on which I assume a penalty would be imposed on Google in this case.[256] Thus, as of June 2025, a deterrent penalty imposed in this matter would need to be at least $12 billion to be consistent with the total inflation-adjusted value of the penalty previously imposed by the European Commission, which is a value that may have at least some measurable impact on Google's stock price.[257]

(144) I note, however, that this $12 billion value likely underestimates the size of the penalty required to have an impact on Google's stock price, given the rapid continued growth in Google's stock price since the time the European Commission penalty was announced. I address this in two alternative ways. First, I calculate the penalty by multiplying Google's WACC for each year from when the European Commission penalty was announced until June 2025. I use Google's WACC in 2024 as an

[256] The (projected) inflation rates in the U.S. are downloaded from Statista. *See* "Projected annual inflation rate in the United States from 2010 to 2029," Statista, April 2024, https://www.statista.com/statistics/244983/projected-inflation-rate-in-the-united-states/.

[257] See my backup materials for details.

approximation of its WACC in 2025. This results in a WACC-adjusted penalty value as of June 2025 of $17.9 billion.[258]

(145) Second, I recalibrate each of the European Commission penalties based on the ratio of Google's market capitalization on August 29, 2024, the most recent day with available market capitalization data, to its market capitalization on the dates when each penalty was initially announced. I expect that the impact of a given penalty on a company's stock price depends on the company's total market capitalization; as Google's market capitalization has grown substantially since the imposition of the European Commission's penalties, it is thus reasonable to scale that penalty to be consistent with Google's current market capitalization. Using this adjustment suggests that a penalty of $25 billion would be needed to have the same relative impact on Google's stock price as the prior European Commission penalties of $9.5 billion.[259]

(146) Thus, I conclude that penalties of between $12 billion and $25 billion, and likely even higher as explained above, would likely be necessary to create a sufficient impact on Google's stock price to ensure that shareholders, not only of Google but also of other similarly situated companies, deter management from engaging in such conduct in the future.

VIII. Penalties of $50 billion would not impair or disrupt **Google's** finances or operations

(147) In his report, Dr. Wiggins claims that "measures of Google's overall financial performance are not relevant for assessing penalties related to the alleged deception."[260] Dr. Skinner similarly questions the relevance of Mr. Andrien's analysis of the financial performance of Alphabet and of Google's advertising business.[261] Dr. Skinner also takes issue with Mr. Andrien's conclusion that a hypothetical $29 billion penalty imposed on Google "would not be so burdensome as to impact the day-to-day operations of the company"[262] and alleges that Mr. Andrien ignores the implications of the penalty for Alphabet's "business, competitive position, and ability to innovate."[263]

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258 See my backup materials for details.

259 See my backup materials for details.

260 Wiggins Report, § VIII.B.

261 Skinner Report, ¶ 59 and § IX; It makes no difference whether the analysis is of Google or Alphabet because in 2023 Google accounted for 99% of Alphabet's revenue and over 100% of its profits as other revenue streams operate at a loss. S&P Capital IQ. See my backup materials for details.

262 Skinner Report, ¶ 65 and § X.

263 Skinner Report, ¶ 15.

(148) Contrary to the conclusions of Dr. Wiggins and Dr. Skinner, an analysis of Google's financial performance and the potential impact of a given penalty amount on Google is highly relevant to assessing the appropriate amount of penalties for several reasons. First, some of the relevant Plaintiff States' statutes, such as the Texas DTPA, explicitly require an evaluation of "the economic effect on the person against whom the penalty is assessed."[264] Second, and central to the analysis of deterrence, it is also important to evaluate whether a given penalty, or range of penalties, would likely constitute "overdeterrence," i.e., whether the amounts are so large that they would either cause Google financial difficulties (such as bankruptcy); limit Google's ability to continue to invest in R&D, make capital expenditures, or acquire technology or complementary businesses (whether through acquisitions or mergers); limit Google's access to capital (whether debt or equity financing); or interfere with Google's day-to-day operations. If so, the penalty amount may constitute overdeterrence, in that it may interfere with otherwise socially beneficial activities, such as continued employment, investment, and innovation, not only for Google, but also for other companies that could potentially cease to engage in certain non-actionable conduct out of a fear of suffering severe financial repercussions from being found liable in an enforcement action. Similar issues of potential "overdeterrence" arise in assessing whether certain conduct is anticompetitive, such as predatory pricing, because penalizing such conduct too heavily (or wrongfully) could result in chilling the most common type of competition – price competition – that antitrust enforcement generally attempts to protect or even promote.

(149) This is not to suggest that in all cases, the imposition of a penalty that resulted in such outcomes would necessarily constitute overdeterrence. In a case in which a company's conduct was so egregious, the harm to the public so extensive, or even the continuing operations of the company under its current ownership of no redeeming social value, it may be appropriate to impose a penalty on a defendant that would result in such an outcome for the defendant, including bankruptcy. In this case, however, the question is whether deterrent penalties consistent with, or even well above those proposed by Mr. Andrien, would likely result in even a modest impact on Google's finances, operations, or future R&D and investment endeavors, given its exceptionally high level of profitability and its substantial financial resources – which are, in part, attributable to the conduct at issue in this case.

(150) To this end, I evaluate alternative financial metrics that allow me to evaluate the financial and operational impact on Google of a deterrent penalty of $50 billion, or even higher amounts, consistent with the range of deterrent penalties I calculate in Section VI.D.[265] In particular, I analyze whether Google has adequate cash and cash equivalents on hand to pay such penalty amounts and

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[264] Texas Deceptive Trade Practices Act, accessed May 29, 2024, https://statutes.capitol.texas.gov/Docs/BC/htm/BC.17.htm, Sec. 17.47(g)(4).

[265] Andrien Report, ¶ 128 and Table 4.

whether doing so would impair or interfere with the company's operations (Section VIII.A). In Section VIII.B, I evaluate Alphabet's share repurchases as a further indication of its ability to generate sufficient cash to pay penalty amounts of $50 billion without disrupting either its operating activities, R&D activities, capital expenditures, or mergers and acquisitions. In Section VIII.C, I show that Alphabet generates substantial free cash flow after allowing for spending on Alphabet's day-to-day operations, as well as after considering its capital expenditures (which help to generate future cash flows). I also discuss how Dr. Skinner's concerns about the potential negative impact of such penalty amounts on Alphabet's equity value ignores the fact that in order to have a deterrent effect, the penalty must have *some* negative impact on shareholders, given the principal-agent problems discussed above. Given the results of my analysis of the impact on Google's stock price of its previous penalties, I expect a penalty of $50 billion would likely have an impact on Google's equity value; however, given the reaction of the company's stock price to past penalties when the company's market capitalization was substantially lower, I would not expect such an impact to interfere with its operations or substantially increase its future cost of equity.[266] Finally, in Section VIII.D, I analyze whether Alphabet has the ability to obtain additional debt financing, which could be used as an alternative funding source for paying the penalties, if Alphabet either were to have an unexpected need for cash, or if it chose to continue its stock repurchase program at its current level (or higher). Each of these alternative funding sources is more than adequate to finance penalties of $50 billion, or even higher amounts.

VIII.A. Google's cash and cash equivalents on hand far exceed a potential penalty of $50 billion

(151) Alphabet Inc., Google's parent company, is currently ranked 8th among the Fortune 500 companies as of July 11, 2024.[267] It was ranked 4th worldwide by market capitalization in 2023,[268] and its current market capitalization is over $2 trillion.[269] It is also very profitable, earning over $300 billion in revenues and $88 billion in operating profit in 2023 alone. Google's revenues and its operating profit have grown substantially over the period at issue, with a CAGR of 18.7% and 19.1%, respectively.[270] Nor does Google appear to be slowing: for 2024, its revenues and profits are forecast to be 13.0%

[266] As discussed above, Google's adjusted stock return on the day that the European Commission first announced the investigation into Google Search was dropped by more than two standard deviations. A two standard deviation drop in Google's adjusted stock return in 2024 corresponds to a $59 billion change in its average market capitalization in 2024, which suggests that a penalty of $59 billion would be needed to have the same relative impact on Google's stock price as the prior European Commission penalties of $9.5 billion. See my Figure 29 backup materials for details.

[267] *See* "Fortune 500 Full List (2024)", 50Pros, accessed September 4, 2024, https://www.50pros.com/fortune500.

[268] "The 100 largest companies in the world by market capitalization in 2023," Statista, accessed September 4, 2024, https://www.statista.com/statistics/263264/top-companies-in-the-world-by-market-capitalization/.

[269] S&P Capital IQ, Alphabet Inc, Historical Capitalization, accessed August 29, 2024.

[270] See my backup materials for details.

and 28.8% higher than in 2023, with revenue and profit in 2025 forecasted to be 11.3% and 14.4% higher than in 2024.[271] Google has achieved very high operating margins throughout this period, even when its revenues were substantially less than they are today, as shown in Figure 24.

Figure 24: Alpha et operating margin, 2013-2023

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Total
Total Revenue ($ billion)	$56	$66	$75	$90	$111	$137	$162	$183	$258	$283	$307	$1,727
Operating Profit ($ billion)	$15	$17	$19	$24	$29	$33	$36	$41	$79	$75	$88	$456
Operating Margin	27.7%	25.6%	25.8%	26.3%	26.1%	23.8%	22.2%	22.6%	30.6%	26.5%	28.7%	26.4%

Source: S&P Capital IQ.
Note: Total revenue and operating profit are rounded to the nearest $ billion, operating margin is calculated using unrounded numbers.

(152) Given its exceptionally large size and profitability, Alphabet has a number of alternative sources of funds available to pay deterrent penalties well above $50 billion. These include: (i.) its currently large amount of available cash and cash equivalents, including funds currently planned for share repurchases; (ii.) the large cash flows generated by its businesses on a current basis; and (iii.) its very large, and largely untapped, sources of external debt financing.

(153) Alphabet's high levels of profits (or cash flows) generated by its business over the years has allowed it to build up and maintain significant reserves of cash and cash equivalents, even after using substantial amounts of cash to fund R&D, capital expenditures, mergers and acquisitions, and stock repurchases over the years.[272] Figure 25, below, shows Alphabet's cash holdings (which includes cash and cash equivalents, as well as highly liquid short-term investments) between 2013 and 2023. Google's current holdings of cash and equivalents of $111 billion (as of the end of 2023) are more than double a fine of $50 billion, clearly demonstrating that the payment of such penalties is feasible for Alphabet.

Figure 25: Alpha et Cash and ST Investments ($ illion), 2013-2023

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Alphabet Inc.	$57.4	$62.6	$71.9	$86.3	$101.9	$109.1	$119.7	$136.7	$139.6	$113.8	$110.9

Source: S&P Capital IQ.

271 S&P Capital IQ. EBIT estimates are used for forecasted profits. See my backup materials for details.

272 Though Alphabet's misconduct is alleged to continue to the present, I restrict my analyses to 2023, the last full year with financials. I reserve the right to update my analyses once full year information for 2024 (or beyond) becomes available.

(154) Given that Alphabet has the ability to pay a $50 billion penalty from the company's current cash balances, i.e., from (in effect) the company's accrued and undistributed past profits, it is also evident that such penalty amounts would also not have any impact on the firm's current and future operations, given the substantial positive cash flows the company generates, and is likely to continue to generate. As shown above, in Figure 24, Alphabet has high operating margins, which already accounts for its R&D spending.[273] Furthermore, Alphabet's current ratio, which is the ratio of its current assets to its current liabilities and measures whether a firm has sufficient working capital,[274] is and has been significantly higher than those of similar firms, as seen in Figure 26, below.[275] The current ratio for Alphabet has exceeded the 75th percentile of those for its peer companies every year, and it also far exceeds the current ratio for the median company in the S&P 500.[276] In addition, reflecting its very low amounts of debt and net interest expense, Alphabet also has, and has had, an exceptionally high interest coverage ratio, which is the ratio of a company's earnings before interest and taxes ("EBIT") to its interest expenses and which reflects its ability to service its debt from its current earnings.[277] Figure 27, below, shows that Alphabet's interest coverage ratio has been higher than the 75th percentile of its peers in almost every year during the period at issue, and it is substantially higher than the S&P 500 median company.

Figure 26: Current Ratio or Alpha e t and compara l e companies, 2013-2023

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Alphabet Inc.	4.58x	4.69x	4.67x	6.29x	5.14x	3.92x	3.37x	3.07x	2.93x	2.38x	2.10x
Peers: 75th percentile	3.09x	2.48x	2.58x	2.35x	2.73x	2.53x	2.35x	2.10x	2.26x	1.82x	1.70x
S&P 500: median company	1.44x	1.44x	1.30x	1.58x	1.66x	1.67x	1.79x	1.67x	1.55x	1.55x	1.55x

Source: S&P Capital IQ.

273 S&P Capital IQ, Alphabet Inc, Income Statement, accessed August 29, 2024. Operating profit is net of R&D spending.

274 Jonathan Berk and Peter DeMarzo, *Corporate Finance*, (Pearson: Third Edition), pp. 36–37.

275 For each year, I identify Alphabet's peers as Nasdaq-listed firms that are headquartered in the U.S., are in the Nasdaq Global Select Market tier of the Nasdaq stock market, and have the same two-digit SIC as Alphabet (i.e., 73). From this set, I further limit the set of peers to be firms that lie in the top 10% in annual revenues, replacing companies that did not have market capitalization data in a given year with the company having the next highest revenue. I use these same peers for all subsequent peer comparisons.

276 I identify the median company in the S&P 500 based on revenues in 2023. Two companies, Henry Schien, Inc. and S&P Global, Inc., have 2023 revenues closest to the 2023 median. Of these two, I select Henry Schein, Inc., as it had greater revenues in prior years (2013–2022). Henceforth, I refer to Henry Schein, Inc. as the "S&P 500 median company" in my analyses. See my backup materials for details.

277 Jonathan Berk and Peter DeMarzo, *Corporate Finance*, (Pearson: Third Edition), pp. 38–39.

Figure 27: Interest Coverage Ratio or Alpha e t and compara le companies, 2013-2023

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Alphabet Inc.	190.2x	167.1x	186.2x	191.3x	265.3x	285.9x	359.3x	305.4x	227.5x	209.6x	286.4x
Peers: 75th percentile	61.1x	237.2x	194.8x	120.5x	94.7x	32.3x	24.3x	35.6x	54.0x	45.6x	55.2x
S&P 500: median company	29.7x	28.1x	26.7x	23.0x	11.1x	11.3x	17.3x	17.0x	22.3x	17.2x	6.9x

Source: S&P Capital IQ.

(155) While Alphabet's cash holdings are substantial, I next assess whether Alphabet has excess cash available, i.e., cash holdings over and above what may be needed for day-to-day operations. Figure 28, below, shows Alphabet's level of cash holdings as a multiple of the firm's current liabilities (i.e., its "cash ratio," a common measure of a firm's liquidity).[278] In order to assess whether Alphabet has excess cash available, I compare Alphabet's cash multiple with those of the peer firms. Alphabet's cash multiple exceeds the 75th percentile every year, and it also far exceeds the cash multiple for the S&P 500 median company. This further indicates that Alphabet has substantial amounts of excess cash holdings on hand, well in excess of its operating or current financing needs.

Figure 28: Cash Ratio or Alpha e t and compara l e companies, 2013-2023

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Alphabet Inc.	3.61x	3.73x	3.72x	5.15x	4.21x	3.15x	2.65x	2.41x	2.17x	1.64x	1.36x
Peers: 75th percentile	2.10x	1.59x	1.85x	1.90x	1.85x	1.67x	1.30x	1.49x	1.46x	1.00x	1.02x
S&P 500: median company	0.08x	0.03x	0.02x	0.03x	0.08x	0.02x	0.05x	0.16x	0.05x	0.05x	0.07x
Panel B: Impact of penalty payment on Alphabet Inc.											
Lump sum: $50B											0.74x
Allocated: $50B	3.60x	3.62x	3.61x	4.99x	4.08x	3.03x	2.54x	2.31x	2.05x	1.52x	1.24x

Source: S&P Capital IQ.
Note: Penalties are allocated proportional to Alphabet's total revenue. *See* Appendix E for penalty allocations by year.

(156) As the literature in financial economics recognizes, companies generally prefer to use their retained earnings as their most preferred source of financing, followed by debt issuance.[279] I next assess the implication of a $50 billion penalty for the cash ratio. I consider two alternative approaches for paying a $50 billion penalty. First, I consider what would have been the impact on Alphabet of paying the penalty amount as a lump sum in 2023. I use 2023 as a proxy for 2025, the earliest that I assume Alphabet would be required to pay a penalty amount and the current trial date; this will overstate the impact on Alphabet of such a lump sum penalty payment, since Alphabet's business has

278 Cash ratio reflects the firm's need for cash to meet its short-term obligations, such as employee pay. *See* Jonathan Berk and Peter DeMarzo, *Corporate Finance*, (Pearson: Third Edition), p. 37.

279 This idea is referred to as the pecking order hypothesis. *See*, e.g., Jonathan Berk and Peter DeMarzo, *Corporate Finance*, Third Edition, Pearson, Chapter 16, p. 570.

continued to grow since 2023, and it is expected to grow further in 2025, as noted above.[280] Second, I consider the impact on Alphabet of financing the penalty amount and, in effect, paying for the financing of the penalty over a period of time from its future cash generated by its operations. Rather than developing a forecast of its future operations and cash holdings, I take an alternative approach of simply assuming that the penalty had been paid out of its revenues earned from November 2013 through 2023.[281] This is a highly conservative approach, as Google's revenues and operating profits today are approximately six times higher than they were in 2013, for example; nonetheless, this approach also has the advantage of allowing for an evaluation of whether the $50 billion penalty is in some sense overly confiscatory of Google's past profits. I show the allocation of the penalty to each period in Appendix E.[282]

(157) As Panel B in Figure 28 above shows, Alphabet's post-payment cash multiple is lower with a lump-sum payment: it is closer to the median cash multiple of its peers (0.79x), but still substantially above the median of the S&P 500. Using an allocation method for penalties, Alphabet's post-payment cash multiple continues to be well above the 75th percentile of its peer companies. Thus, a penalty of $50 billion can be paid from Alphabet's substantial excess cash holdings. In addition, if the penalty had been assessed on a pro-rata basis on Alphabet's past earnings during the years at issue, it could also have easily made these payments without disrupting its operating activities; in other words, the lack of any operational impact on Alphabet of a fine of this magnitude is not simply a reflection of its current high level of profits, but also is supported by its financial performance during the years at issue. If Alphabet were to finance the penalties in some other way, such as by issuing additional debt, it would have even less of an impact on its going-forward operating and investing activities.

VIII.B. **Alphabet's** frequent and substantial share repurchases demonstrate its cash available to pay a potential penalty of $50 billion

(158) Over the years, Alphabet has used the cash generated from its operations to repurchase a substantial volume of its shares through multiple share repurchase programs. Figure 29, below, lists all such repurchase programs since 2013. Cumulatively, Google has authorized share repurchases of $346 billion, of which $240 billion in cumulative repurchases had been completed through the end of 2023.[283] This shows the availability of substantial amounts of cash that Alphabet has chosen to

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280 In 2024, Alphabet's revenues and profits are forecast to be 13.0% and 28.8% higher than in 2023, with revenue and profit in 2025 forecasted to be 11.3% and 14.4% higher than in 2024. S&P Capital IQ. See my backup materials for details.

281 The earliest start date for a DTPA claim is November 11, 2013. *See* Andrien Report, Exhibit 2, note 8.

282 Because the penalty assigned to each year does not account for the time value of money, the impact of the penalty on Alphabet is exaggerated.

283 S&P Capital IQ; Form 10-K filings, 2015-2023. See my backup materials for details.

return to shareholders, which were not needed for its operating or investing activities (including for its many acquisitions). This amount, when combined with excess cash holdings discussed above, further demonstrates the feasibility of Alphabet paying the penalty without affecting its business operations.

Figure 29: Alpha et Inc. stock repurchase announcements and time to completion, 2013-2024

Announcement index	Amount ($ million)	Date announced	Total quarters to completion
1	$5,099	Oct-15	3
2	$7,019	Oct-16	6
3	$8,590	Jan-18	5
4	$12,500	Jan-19	4
5	$25,000	Jul-19	5
6	$28,000	Jul-20	4
7	$50,000	Apr-21	5
8	$70,000	Apr-22	5
9	$70,000	Apr-23	5+
10	$70,000	Apr-24	1+

Source: S&P Capital IQ; Alphabet Inc., Form 10-K filings, 2015-2023; Alphabet Inc., Q3 2015 Earnings Call, Oct 22, 2015, 6; Alphabet Inc., Q3 2016 Earnings Call, Oct 27, 2016, 7; Alphabet Inc., Q1 2024 Earnings Call, April 25, 2024, 10.
Notes: Where no specific end dates are given for a repurchase announcement, repurchase end dates are calculated for a given announcement using a first in, first out method. When there are overlapping stock repurchase announcements, stock repurchases are allocated to the earlier announcement. Repurchase announcements are considered completed in the quarter they are paid off.

(159) In his analysis of the potential effect of a $29 billion penalty on Alphabet, Mr. Andrien points to Alphabet's recent $70 billion share repurchase announcement as an indication that Alphabet could simply limit the size of its share repurchases and instead use some of this cash to pay for the penalty instead.[284] Dr. Skinner, however, criticizes Mr. Andrien for failing to assess the potential negative impact of a change in Alphabet's announced share repurchase plan on the firm's operations and its shareholders.[285] Dr. Skinner does not provide any evidence to suggest that such a change would likely have a significant impact, either on the company's operations or its shareholders.

(160) In fact, Dr. Skinner ignores the common motivation for share repurchases: firms generally repurchase their shares when they have excess cash (in excess of their operating or investing needs); or if they want to change the capital structure by increasing the share of debt (generally, a less expensive source of capital) relative to equity (generally, a relatively more expensive source of capital). In the case of Alphabet, the reason for share repurchase is in line with its exceptionally high cash holdings, above and beyond its operating and investing needs, as discussed above, and not driven by the need

[284] Andrien Report, ¶ 139.

[285] Skinner Report, ¶ 72.

to increase its debt to equity ratio (which, as I discuss below, was quite low even with the share repurchase plan already in place). Furthermore, by the very nature of the program, a decision to use the surplus funds to pay a penalty imposed on Alphabet for alleged misconduct in place of share repurchases would not prevent Alphabet from pursuing profitable investment opportunities. The share repurchase decision is a strong signal that Alphabet does not have additional positive NPV projects available to which the funds allocated for the stock repurchase program can be applied.[286] That is, in fact, the very reason firms return excess cash to shareholders: they simply do not have a way of using that cash to generate additional returns to shareholders in excess of the firm's cost of capital.

(161) Dr. Skinner's concerns regarding a potentially negative implication of reversing Alphabet's share repurchase program are exaggerated, particularly in comparison with reversing an alternative form of payout, namely dividends. Because dividends represent a commitment to future payouts, markets tend to penalize firms that cut dividends. On the other hand, there is no implicit or explicit obligation for a firm to follow through with an announced share repurchase program, nor an expectation of continued future programs.[287] In fact, Alphabet's history provides evidence of the inherent financial flexibility in share repurchases. As Figure 29 above shows, Alphabet has announced multiple share repurchase plans over the years. However, there have been variations in the time between plans, the size of the plans, and the duration over which the plans have been implemented. Because share repurchases allow firms to preserve financial flexibility, one would not expect there to be a significant cost to Alphabet (e.g., in the form of an increase in its future cost of equity) if it were to reverse the program, whether in whole or in part.

(162) Furthermore, Dr. Skinner's concern regarding the potential adverse signaling effect to shareholders is irrelevant in assessing whether the penalty will actually be sufficient to deter such conduct in the future, either by Google or by other similarly situated companies. As discussed above, in light of the principal-agent problem, in order for the penalty to have any deterrent effect, it needs to be sufficiently large for shareholders to have an incentive to deter the type of conduct that led to the imposition of the penalty. Thus, from a deterrence perspective, if there were a negative stock reaction to a rollback of the current share repurchase plan (in part or in its entirety) for paying the penalty, some negative reaction would be a *desirable* effect of the penalty amount, not a drawback, as Dr. Skinner assumes.

(163) In fact, the company's share repurchases are an underestimate of the available cash the company has available to pay a penalty. As shown above, in recent years, Alphabet has been able to continue

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[286] Richard Brealey, Stewart Myers, and Franklin Allen, *Principles of Corporate Finance*, (McGraw Hill, Eighth Edition), Chapter 16, p. 420.

[287] Murali Jagannathan, Clifford Stephens, and Michael Weisbach, "Financial Flexibility and the Choice Between Dividends and Stock Repurchases," *Journal of Financial Economics* 57 (2000): 355–384, at 356.

to replenish its cash balances – including its excess cash – out of the continued profitability and growth of its current operations while simultaneously engaging in continuous large share buyback programs. Thus, in this context, its excess cash holdings (consistently being replenished from current cash flows) and the funds it has available for share buybacks are two alternative sources of funds that Alphabet has available for paying penalties. To estimate the likely maximum available cash from both these sources, I consider: (i.) Alphabet's *excess* cash holdings, based on the difference between Alphabet's and the median firm's cash ratio multiple; and (ii.) funds used for Alphabet's share repurchase programs. Figure 30, below, shows Alphabet's ability to pay up to $107.7 billion in 2023 alone, far in excess of a $50 billion penalty.

Figure 30: Alpha et Inc. potential cash holdings ($ million), 2023

Category	2023
Excess Cash & ST Investments (year-end balance)	$46,236
Stock buybacks (purchased during 2023)	$61,504
Total	$107,740

Source: S&P Capital IQ
Note: Excess Cash & ST Investments is calculated as the difference between Alphabet's cash holdings and the amount of cash if Alphabet had the median comparable company's Cash Ratio. Stock buybacks reflects the repurchase of common stock from Alphabet's 2023 Form 10-K Cash Flow Statement. In April 2023, Alphabet announced a $70 billion share buyback of which $65.2 billion was repurchased as of June 30, 2024. See my Figure 29 backup materials for details.

VIII.C. **Google's f**ree cash flow from operations in a single year exceed a potential penalty of $50 billion

(164) In assessing the reasonableness of his proposed penalty, Mr. Andrien notes that the penalty would not "impact the day-to-day operations" of Alphabet.[288] Dr. Skinner takes exception and criticizes Mr. Andrien for not defining what "day-to-day operations" could mean.[289] Because a penalty that disrupts a company's operations may constitute "overdeterrence," in this section, I address Dr. Skinner's concern by calculating Alphabet's cash flow from its operations each year, which takes into account its ability to pay its operating expenses, pay for its R&D activities, service its debt, and provide sufficient cash for net working capital to maintain the firm's day-to-day operations.

(165) Figure 31, below, shows that Alphabet generated over $100 billion in cash flows from operations in 2023 alone. This is more than adequate to pay a penalty of $50 billion. In fact, Alphabet's cash flow from operations would have been sufficient to make such a payment in each year from 2020 through 2023.

[288] Andrien Report, ¶ 131.

[289] Skinner Report, ¶ 15.

(166) Dr. Skinner also states that such penalty amounts would, or may, have adverse consequences on Alphabet's "business, competitive position, and ability to innovate."[290] I consider several categories of spending that would have implications for Alphabet's longer-term competitiveness and performance, namely its capital expenditures and its acquisitions financed through cash (its R&D expenditures, another potential source for firms' competitiveness and presumably the source of the company's "ability to innovate," is already addressed in my analysis of the cash flow from operations). As Figure 31, below, shows, after allowing for capital expenditures (and with adjustment for any change in the level of debt, which is quite small), Alphabet still generated enough free cash flow (i.e., free cash flow to equity) to pay a $50 billion penalty in every year from 2020 through 2023.

(167) Even after allowing for cash acquisitions from these cash flows, Alphabet would have had sufficient surplus cash holdings after paying the penalty as a lump sum in 2023, or if one were to allocate the penalty payment to each of the prior years from November 2013 through 2023 (see Panel B in Figure 31, below).

Figure 31: Alpha et Free Cash Flow to Equity ($ illion), 2013-2023

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Cash Flow from Operating Activities	$18.7	$23.0	$26.6	$36.0	$37.1	$48.0	$54.5	$65.1	$91.7	$91.5	$101.7
Change in Total Debt from previous year	-$0.6	$1.4	-$0.4	-$3.7	$0.0	$0.0	$12.1	$11.8	$0.6	$1.5	-$0.1
Capital Expenditures	-$7.4	-$11.0	-$10.0	-$10.2	-$13.2	-$25.1	-$23.5	-$22.3	-$24.6	-$31.5	-$32.3
Free Cash Flow to Equity	$10.7	$13.4	$16.3	$22.1	$23.9	$22.9	$43.0	$54.6	$67.6	$61.5	$69.4
Cash Acquisitions	-$1.4	-$4.9	-$0.2	-$1.0	-$0.3	-$1.5	-$2.5	-$0.7	-$2.6	-$7.0	-$0.5
Free Cash Flow to Equity (less Cash Acquisitions)	$9.3	$8.5	$16.0	$21.1	$23.7	$21.4	$40.5	$53.9	$65.0	$54.5	$68.9
Panel B: Impact of penalty payment on Alphabet Inc. on Free Cash Flow to Equity (less Cash Acquisitions)											
Lump sum: $50B											$18.9
Allocated: $50B	$9.0	$6.6	$13.8	$18.4	$20.4	$17.3	$35.7	$48.5	$57.4	$46.1	$59.7

Source: S&P Capital IQ.
Note: Penalties are allocated proportional to Alphabet's total revenue. *See* Appendix E for penalty allocations by year.

(168) Ultimately, Alphabet's market capitalization is, in effect, the market's estimate of the company's discounted *future* free cash flow to equity holders. As of the end of 2023, Alphabet's market capitalization was $1.75 trillion, while it is currently over $2 trillion, which is 40 times higher than a $50 billion penalty.[291] This further indicates that Alphabet will be able to bear the cost of the penalty

[290] Skinner Report, ¶ 15.

[291] S&P Capital IQ, Alphabet Inc, Historical Capitalization, accessed August 29, 2024.

amounts, whether paid as a lump sum out of its current cash or financed and spread over future years out of its future earnings.

VIII.D. Alphabet has a substantial ability to raise additional debt to pay a potential $50 billion penalty, if needed

(169) Instead of using its substantial excess available cash, Alphabet could also simply issue new debt as an alternative funding source to make the penalty payments of $50 billion. As Figure 32 shows, in every year except 2013, Alphabet's debt to market capitalization ratio was lower than that of the 25th percentile of its peers, and significantly lower than the median S&P 500 company, indicating its exceptionally low level of debt. Its total debt outstanding (including current portions of long-term debt and leases) as of the end of 2023 was only $29.9 billion;[292] it also had $10 billion available on credit lines, which it rarely appears to have used.[293] If Google were to increase its debt to achieve the (still exceptionally low) median debt to market capitalization ratio of its peers in 2023 (i.e., 0.05x), Google could raise an additional $49.4 billion in debt; using the debt to market capitalization ratio of the median company in the S&P 500 that I identified previously, 0.28x, implies that Google could raise an additional $459.2 billion in debt.[294] Alphabet's high-grade long-term issuer credit rating by Moody's (Aa2) further indicates that it would be able to raise an additional $50 billion worth of debt, or substantially more, relatively cheaply, if it chose to fund the penalty payment in this way.[295]

Figure 32: Total De t / Market Capitalization: Alpha et and compara le companies, 2013-2023

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Alphabet Inc.	0.02x	0.02x	0.01x	0.01x	0.01x	0.01x	0.02x	0.02x	0.01x	0.03x	0.02x
Peers: 25th percentile	0.01x	0.04x	0.02x	0.04x	0.02x	0.02x	0.03x	0.04x	0.03x	0.05x	0.03x
S&P 500: median company	0.05x	0.06x	0.06x	0.10x	0.15x	0.16x	0.10x	0.11x	0.12x	0.14x	0.28x

Source: S&P Capital IQ.

292 This includes $17 billion in long-term leases, with the remaining $12.9 billion as long-term debt. *See*, S&P Capital IQ, Alphabet Inc, Balance Sheet, accessed August 29, 2024.

293 S&P Capital IQ, Alphabet Inc, Historical Capitalization, accessed August 29, 2024; Alphabet Inc., *Form 10-K 2023,* January 30, 2024, 42.

294 See my backup for details.

295 Moody's, "Alphabet Inc. LT Issuer Ratings & Assessments," accessed August 29, 2024, https://www.moodys.com/credit-ratings/Alphabet-Inc-credit-rating-824906971/ratings/view-by-class; *See also* Moody's, "Rating Scale and Definitions," accessed September 4, 2024, https://www.moodys.com/sites/products/productattachments/ap075378_1_1408_ki.pdf.

IX. Conclusion

(170) In summary, based on the foregoing, I conclude that Dr. Wiggins's and Dr. Skinner's opinions regarding the scope and effect of the conduct at issue, the number of statutory violations, the benefits to Google, the amount of appropriate penalties, and the financial impact of potential penalties on Google are without merit. Contrary to their opinions, I conclude the following:

- First, from a methodological perspective, Dr. Wiggins focuses only on measuring the incremental benefits to Google from the alleged conduct.[296] On the contrary, from an economic perspective, an appropriate deterrent amount should consider the total amount of harm, the total amount of benefit, and the probability of detection; the latter factor in particular will result in a deterrent penalty many multiples of the actual or expected benefit to Google or harm to society (including harm to publishers, advertisers, competitors, consumers, and the competitive process).
- Second, from a methodological perspective, Dr. Wiggins ignores the extensive academic literature on the "principal-agent" problem, which suggests that an appropriate deterrent penalty should account for the principal-agent problem inherent in Alphabet's corporate governance; and if the jury concludes that the conduct at issue is sufficiently severe and extensive, the deterrent penalty should be set sufficiently high to have at least some measurable impact on Alphabet's stock price.
- Third, Dr. Wiggins focuses in his penalty analysis only on the incremental profits earned by Google from its AdX business in the Plaintiff States.[297] By contrast, I conclude that the relevant amount of commerce impacted by the conduct at issue is far greater, ranging between [redacted] and potentially $1.38 trillion in Google booked revenue, and between [redacted] in Google operating profit, depending on whether the conduct only affected Google's DVAA business, or if it affected more broadly Google's advertising business on its own properties, including YouTube, Gmail, and Search, for example.
- Fourth, Dr. Wiggins concludes that the conduct at issue resulted in at most 579 billion violations.[298] In contrast, I conclude that approximately [redacted] were likely affected by Google's conduct at issue; and depending on what specific conduct the jury determines to be a violation of the relevant statutes, the number of Google's statutory violations in the Plaintiff States may be 7.7 trillion. Even if one were to accept Dr. Wiggins's estimate of 579 billion transactions, it would not affect the appropriate deterrent penalty amount, given the scope and severity of the conduct at issue.

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296 Wiggins Report, ¶ 121.

297 Wiggins Report, Section VII.

298 Wiggins Report, Table 1.

- Fifth, Dr. Wiggins concludes that appropriate penalties should be between $22 million and $141 million, although he ultimately concludes they should be zero, since Google was unable to benefit from the conduct.[299] In contrast, using Google's own estimates of the expected benefits from the conduct at issue, and applying reasonable estimates of the probability of detection, enforcement, and penalty collection, I calculate deterrent penalties in the range of between $14.8 billion and $124.4 billion as of June 2025; or between $10.7 billion and $75.9 billion, assuming a 20-year limited duration of the expected benefits; or between $9.6 billion and $43.7 billion, if based on the expected realized benefits of the programs over the years at issue. A reasonable fact finder could determine that the appropriate penalty is within these ranges or, potentially, even higher, particularly in light of the other factors that the jury may consider in keeping with statutory guidance. While the methodology described above provides wide ranges of potential deterrent penalty amounts, due in large part to the impact of alternative assumptions regarding the probability of detection, enforcement, and penalty collection, I consider a 20% probability to provide a reasonable basis with which to derive a mid-point estimate for those ranges.
- Sixth, Dr. Wiggins concludes that Google's prior conduct, and the penalties associated with that conduct, are irrelevant to determining the appropriate penalty amount in this case.[300] In contrast, I conclude that based on a statistical analysis of the impact of prior penalty amounts on Google's stock price, and given the substantial scope, extent, and profitability of the conduct at issue, a penalty would need to be in the range of $12 billion to $25 billion, and likely higher, to have a sufficiently detectable impact on the company's stock price to deter Google and similarly situated companies from engaging in similar conduct in the future.
- Seventh and finally, Dr. Skinner concludes that Google's stock repurchases, R&D activities, and other factors do not support the conclusion that a $29 billion penalty could be imposed on the company without significant ramifications.[301] In contrast, I conclude that based on Google's profitability, its cash from operations, its excess cash on hand, the value of its stock repurchases, and its borrowing capacity, deterrent penalties of $50 billion, or more, would not adversely affect the company's current operations, its R&D activities, its ability to make additional capital investments, or its access to capital markets.

[299] Wiggins Report, ¶ 19, Figure 3.

[300] Wiggins Report, § VII.C.

[301] Skinner Report, § X.

	September 9, 2024
David W. DeRamus, Ph.D.	Date

Appendix A. Curriculum vitae of David DeRamus

A.1. Summary of experience

David W. DeRamus is a founding member of Bates White Economic Consulting and is active in the firm's Antitrust and Competition, Energy, Finance, International Arbitration and Trade, and Transfer Pricing and Tax Practices. He specializes in economic and financial analysis, quantitative modeling, antitrust analysis, pricing analysis, damages analysis, and valuation. Dr. DeRamus has an extensive background in industrial organization, international economics, antitrust economics, microeconomics, finance, financial modeling, and statistics.

A.2. Education

- PhD, Economics, University of Massachusetts at Amherst
- MA, Economics, University of Massachusetts at Amherst
- BA, Political Science (*magna cum laude*), Duke University

A.3. Professional Experience

- Dr. DeRamus was previously a Manager with A.T. Kearney and a Senior Manager with KPMG. In both positions, he had broad client responsibility including the management of complex litigation, transfer pricing, and business consulting engagements.

A.4. Last ten years of deposition and trial testimony (see selected experience for more details)

- On behalf of the State of Texas, served as economic expert in *State of Texas v. Meta Platforms, Inc. fka Facebook, Inc.*, Cause No. 22-0121, District Court 71st Judicial District, Harrison County, Texas.
- On behalf of the South Carolina Department of Revenue, served as economic expert in *Home Depot USA, Inc. v. South Carolina Department of Revenue* (State of South Carolina Administrative Law Court, Docket No. 22-ALJ-17-0176-CC).

- On behalf of the South Carolina Department of Revenue, served as economic expert in *CarMax Auto Superstores, Inc. v. South Carolina Department of Revenue* (State of South Carolina Administrative Law Court, Docket No. 21-ALJ-17-0182-CC).
- On behalf of Plaintiffs, served as economic expert in *Liu Chin Mei, Tong-Schung Tai and Robert Shi, as Executors of the Will of Yueh-Lan Wang v. New Mighty U.S. Trust, New Mighty Foundation, and Clearbridge LLC*, U.S. District Court for the District of Columbia (Civil Action No. 1:10-cv-01743 (JEB).
- On behalf of the US Internal Revenue Service, served as economic expert in *Western Digital Corporation and Subsidiaries v. Commissioner of Internal Revenue*, U.S. Tax Court (Docket Nos. 18984-18, 4818-19).
- On behalf of the U.S. Department of Justice, served as economic expert in *Perrigo Company and Subsidiaries v. United States of America*. U.S. District Court, Western District of Michigan (No. 1:17-cv-00737).
- On behalf of the Debtors, served as economic expert in *In re Purdue Pharma L.P.*, U.S. Bankruptcy Court, Southern District of New York (Case No. 19-23649).
- On behalf of the South Carolina Department of Revenue, served as economic expert in *Tractor Supply Company v. South Carolina Department of Revenue* (State of South Carolina Administrative Law Court, Docket No. 20-ALJ-17-0416-CC).
- On behalf of the South Carolina Department of Revenue, served as economic expert in *AutoZone Investment Corporation v. South Carolina Department of Revenue* (State of South Carolina Administrative Law Court, Docket No. 20-ALJ-17-0068-CC).
- On behalf of Radwell International, served as economic expert in *Rockwell Automation v. Radwell International*, U.S. District Court, District of New Jersey (15-cv-05246 (RBK) (JS)).
- On behalf of Radwell International, served as economic expert in *In the Matter of Certain Programmable Logic Controllers, Components Thereof, and Products Containing Same*, International Trade Commission Investigation No. 337-TA-1105.
- On behalf of the State of Mississippi, served as economic expert in *The State of Mississippi, Ex Rel. Jim Hood, Attorney General for the State of Mississippi v. Entergy Mississippi, Inc., et al.* in U.S. District Court for the Southern District of Mississippi (Civil Action No. 3:08cv780-CWR-LRA).
- On behalf of the Electric Power Supply Association et al., submitted declaration in *Electric Power Supply Association et al. v. Anthony M. Starr et al.* (U.S. District Court for Northern District of Illinois Eastern Division, Case No. 17-cv-01164).
- On behalf of the Electric Power Supply Association, submitted an affidavit in proceedings before the Federal Energy Regulatory Commission ("FERC") in *PJM Interconnection, L.L.C.* (FERC Docket No. RM18-1314-000).

- Submitted affidavit in proceedings before the FERC related to Grid Reliability and Resilience Pricing (FERC Docket No. RM18-1-000).
- On behalf of Trans Ova Genetics, served as economic expert in *XY, LLC v. Trans Ova Genetics LLC* (United States District Court for the District of Colorado, Case No. 1:13-cv-00876-WJM-NYW).
- On behalf of Nest Labs, served as economic expert in *Allure Energy, Inc. v. Nest Labs, Inc.*, Civil Action No. 9–13–CV–102, 84 F. Supp. 3d 538, (E.D. Tex. 2015).
- On behalf of Vote Solar, served as economic expert in *In the Matter of the Investigation of the Costs and Benefits of PacifiCorp's Net Metering Program* before the Public Service Commission of Utah (Docket No. 14-035-184).
- On behalf of the Energy Freedom Coalition of America, served as economic expert in proceedings before the Arizona Corporation Commission (*In the Matter of the Application of Tucson Electric Power Company for the Establishment of Just and Reasonable Rates and Charges Designed to Realize a Reasonable Rate of Return on the Fair Value of the Properties of the Tucson Electric Power Company Devoted to its Operations Throughout the State of Arizona and for Related Approvals; and In the matter of the Application of Tucson Electric Power Company for Approval of its 2016 Renewable Energy Standard and Tariff Implementation Plan*; Docket No. E-01933A-15-0322).
- On behalf of Pluspetrol Peru Corporation S.A. and others, served as economic expert before the International Center for Settlement of Investment Disputes in *Pluspetrol Peru Corporation S.A. and others v. Perupetro S.A.* (ICSID Case No. ARB/12/28).

A.5. Selected litigation experience

- On behalf of the State of Texas, served as economic expert in *State of Texas v. Meta Platforms, Inc. fka Facebook, Inc.*, Cause No. 22-0121, District Court 71 st Judicial District, Harrison County, Texas. Testified on the economic benefits to Meta of facial recognition technology, quantified the extent to which it applied facial recognition technology to images of Texas residents, and addressed other issues related to alleged violations of the Texas Capture or Use of Biometric Identifier ("CUBI") Act and Deceptive Trade Practice Act ("DTPA").
- On behalf of Plaintiffs, served as economic expert in *Liu Chin Mei, Tong-Schung Tai and Robert Shi, as Executors of the Will of Yueh-Lan Wang v. New Mighty U.S. Trust, New Mighty Foundation, and Clearbridge LLC*, U.S. District Court for the District of Columbia (Civil Action No. 1:10-cv-01743 (JEB). Testified on valuation issues related to a petrochemical business.
- On behalf of the US Internal Revenue Service, served as economic expert in *Western Digital Corporation and Subsidiaries v. Commissioner of Internal Revenue*, U.S. Tax Court (Docket Nos.

18984-18, 4818-19). Testified on transfer pricing issues related to the hard-disk drive (HDD) business; analyzed the development and value of HDD technology; and determined arm's-length pricing for various intercompany transactions.

- On behalf of the U.S. Department of Justice, served as economic expert in *Perrigo Company and Subsidiaries v. United States of America*. U.S. District Court, Western District of Michigan (No. 1:17-cv-00737). Testified on transfer pricing issues, the structuring of certain related party transactions, and the economic effects of those transactions. Analyzed economic issues related to the development of over-the-counter omeprazole, the value of that business, and the determination of arm's-length prices for related-party transactions associated with that business.
- Served as economic expert on transfer pricing issues in the Purdue Pharma Chapter 11 proceedings (*In re Purdue Pharma L.P.*, U.S. Bankruptcy Court, Southern District of New York, Case No. 19-23649). On behalf of the Debtors, analyzed the value of intercompany transfers between Purdue Pharma and the Independent Associated Companies ("IACs") and other Sackler-owned entities. Analyzed intellectual property licenses, intellectual property rights transfers, manufacturing services, finished goods transfers, active pharmaceutical ingredients ("API") transfers, R&D services, administrative services, real estate transactions, and transfers of equity interests in third parties and other related party companies.
- On behalf of the South Carolina Department of Revenue, testified on transfer pricing issues in *Home Depot USA, Inc. v. South Carolina Department of Revenue* (State of South Carolina Administrative Law Court, Docket No. 22-ALJ-17-0176-CC). Analyzed related-party transactions involving headquarters services, procurement, merchandising, trademarks, intercompany loans, and retail operations; analyzed related party restructuring.
- On behalf of the South Carolina Department of Revenue, testified on transfer pricing issues in *CarMax Auto Superstores, Inc. v. South Carolina Department of Revenue* (State of South Carolina Administrative Law Court, Docket No. 21-ALJ-17-0182-CC). Analyzed related-party transactions involving headquarters services, auto financing, trademarks, and other asserted intangible assets; analyzed valuation of intangible assets as part of a related party restructuring.
- On behalf of the South Carolina Department of Revenue, testified on transfer pricing issues in *Tractor Supply Company v. South Carolina Department of Revenue* (State of South Carolina Administrative Law Court, Docket No. 20-ALJ-17-0416-CC). Analyzed related-party transactions involving tangible goods, headquarters services, and trademarks.
- On behalf of the South Carolina Department of Revenue, testified on transfer pricing issues in *AutoZone Investment Corporation v. South Carolina Department of Revenue* (State of South Carolina Administrative Law Court, Docket No. 20-ALJ-17-0068-CC). Analyzed related-party transactions involving tangible goods, headquarters services, financing, and trademarks.

- Submitted expert report in proceedings before the American Arbitration Association in a contract dispute related to a retail business and the sale of property to the U.S. government. Analyzed the impact of certain contractual provisions in a partnership agreement on the appropriate distribution of proceeds from the sale of property; and assessed the value of different components of related retail businesses.
- Serving as a consulting expert in several ongoing matters related to cryptocurrencies, cryptocommodities, and other digital assets, including allegations of market manipulation and other causes of action.
- Served as testifying expert on antitrust issues and damages in *Rockwell Automation v. Radwell International*, U.S. District Court, District of New Jersey (15-cv-05246 (RBK) (JS)), a case involving Lanham Act trademark infringement claims and antitrust counterclaims.
- *In the Matter of Certain Programmable Logic Controllers, Components Thereof, and Products Containing Same*, International Trade Commission Investigation No. 337-TA-1105, submitted expert report on antitrust issues, including relevant market definition, monopoly power, anticompetitive conduct, imports, and injury to a domestic industry. Also analyzed alleged trademark infringement.
- Testified at trial in *XY, LLC v. Trans Ova Genetics LLC*, a patent infringement and antitrust dispute in the livestock reproductive services industry. Testified on behalf of Counterclaim Plaintiff Trans Ova Genetics on issues related to relevant market definition, monopoly power, anticompetitive conduct, and damages.
- Testified at trial in *ZF Meritor LLC v. Eaton Corp.*, a monopolization case involving heavy-duty truck transmissions. On behalf of plaintiffs, submitted testimony defining the relevant antitrust market, assessing whether a market participant had monopoly power, and evaluating the harm to competition from certain contracts and the performance of those contracts; also submitted testimony estimating damages. Jury verdict on liability in favor of client, upheld on appeal (*ZF Meritor v. Eaton Corp.*, 696 F.3d 254 (3d Cir. 2012), cert denied, 133 S.Ct. 2025 (2013)). Prior to the damages phase of trial, the parties agreed to a $500 million settlement.
- Served as consulting expert in international trade dispute before the World Trade Organization. Analyzed the industry and markets at issue, assessed impact of certain government support programs on that country's industry, and evaluated potential impact of such programs on another country's domestic and export commerce. Analyzed economic evidence of serious prejudice, adverse effects, and injury resulting from the alleged subsidies.
- In *The State of Mississippi, Ex Rel. Jim Hood, Attorney General for the State of Mississippi v. Entergy Mississippi, Inc.*, et al. in U.S. District Court for the Southern District of Mississippi (Civil Action No. 3:08cv780-CWR-LRA), submitted testimony related to Entergy's alleged failure to

purchase adequate amounts of lower-cost electric power from third parties. Evaluated Entergy's conduct and estimated damages.

- Submitted expert testimony in *In re Methionine Antitrust Litigation*, a major price-fixing case involving feed additives on behalf of direct action opt-out plaintiffs. Issues included establishment of liability, estimation of damages, analysis of industry structure, analysis of financial performance, and other pricing-related issues.
- Submitted declaration on behalf of independent power producer Plaintiffs in *Electric Power Supply Association et al. v. Anthony M. Starr et al.* (U.S. District Court for Northern District of Illinois Eastern Division, Case No. 17-cv-01164), a dispute arising from a state subsidy program for certain nuclear generating units that otherwise would have retired. Analyzed the impact of the subsidies on wholesale market prices; irreparable harm to markets and consumers; and undue in-state preferences.
- Served as a Technical Expert in a contract dispute between two petrochemical companies in administered expert proceedings before the International Chamber of Commerce (ICC)/International Centre for ADR. The scope of the assignment was to determine an appropriate reference price to be used by the Parties for the remaining period of a long-term supply contract.
- Served as testifying expert before the International Center for Settlement of Investment Disputes in a royalty dispute involving a major natural gas extraction and LNG project in Latin America. The LNG produced from the project was exported to customers in Mexico, the U.S., and other global natural gas markets. Testified on behalf of a consortium of producers on issues related to the economics of the contract, industry practices, the impact on the parties of recent developments in global natural gas markets, the commercial causes and consequences of "re-exports" from certain global LNG terminals, the appropriate calculation of royalties, and damages.
- Submitted a declaration in *Allure Energy, Inc. v. Nest Labs, Inc.* on behalf of defendant Nest Labs. Performed economic analysis of the four eBay factors to assess whether a preliminary injunction against Nest Labs should be granted for alleged patent infringement. Plaintiff's request for a preliminary injunction was denied.
- Testified in proceedings before the American Arbitration Association in a contract dispute between chemical manufacturers. Testified on issues related to the economics of the contract, the value to the parties of the contract, the impact of foreign exchange rate changes on the value of the contract, the competitive alternatives available to the parties, and damages.
- Testified in proceedings before the American Arbitration Association in a contract dispute between defense contractors. Testified on issues related to the materiality of the failure to

disclose a government investigation, the economic analysis of a subcontract and alleged joint venture agreement, and damages.

- Served as consulting expert in international arbitration proceedings (International Chamber of Commerce) related to a dispute in the pharmaceutical industry. Estimated damages associated with the alleged breach of contract.
- Submitted expert testimony in *T.E. Security Consultants v. DynCorp Int'l*, a contract dispute between defense contractors. Testified on issues of the financial ability of one of the parties to perform on a contract, a party's ability to obtain financing, the economic analysis of an alleged subcontract, the value of alleged trade secrets, and damages.
- Submitted testimony and testified at hearing in *Jenkins v. Entergy Corp.* estimating damages to plaintiffs resulting from an alleged improper energy purchasing scheme; submitted testimony in class certification proceeding.
- Testified on behalf of the Maryland Public Service Commission Staff to assess potential market power issues associated with the proposed merger of Exelon Corporation and Constellation Energy Group, Inc. Analyzed changes in market concentration, the definition of relevant geographic markets, and Applicants' proposed mitigation plan. Assessed the economic viability of the facilities selected for divestiture by the Applicants. Provided testimony on the Applicants' proposal to build additional generation as a means of addressing market power concerns raised by the proposed merger.
- Testified on behalf of the Energy Freedom Coalition of America before the Arizona Corporation Commission regarding a proposal by Tucson Electric Power Company related to residential distributed generation (DG) and the Arizona Renewable Energy Standard and Tariff. Analyzed the impact of proposed tariff changes on customers and competition.
- Submitted expert testimony on behalf of indirect purchaser plaintiffs in class certification proceedings in *J&R Ventures, Inc. v. Rhone-Poulenc SA*, a price-fixing case involving feed additives.
- Submitted testimony on behalf of Constellation Energy Commodities Group, Inc., in a complaint proceeding before FERC (Docket No. EL07-47-000) brought by the Illinois Attorney General against various participants in the Illinois Auction for electric power supplies held in September 2006. Analyzed issues related to the competitiveness of the auction structure, market concentration, the ability of the participants to exercise market power, and allegations of collusion.
- Submitted expert report to FERC related to alleged market manipulation in energy markets.
- Served as consulting expert on behalf of plaintiffs for monopolization cases involving the computer software industry. Assisted with the development of overall case strategy and preparation of economic analysis used in legal filings, analyzed pricing issues, investigated and

reviewed allegations of anticompetitive behavior, prepared damage estimates, submitted damage reports to clients, and assisted with settlement negotiations.

- Served as consulting expert on behalf of multiple defendants in several large cases related to the natural gas industry on class certification and damages issues. Alleged conduct involved misreporting of prices to publishers of natural gas price indices.
- Served as consulting expert on antitrust, pricing, and exclusionary conduct issues related to biotechnology and agricultural products. Analyzed potential anticompetitive harm resulting from a proposed acquisition.
- Provided economic analyses related to antitrust issues involving the electric utility industry. Analyzed prices, load patterns, capacity issues, outages, bidding patterns, and allegations of anticompetitive behavior.
- Submitted various expert reports in transfer pricing disputes before the Mexican tax authority (Servicio de Administración Tributaria) related to transfer pricing. These reports evaluated whether various related-party transactions were consistent with the arm's length standard under OECD and Mexican transfer pricing guidelines.
- Served as consulting expert services to the U.S. Department of Justice in a major government contract dispute. Assessed the economics of a development contract with defense aerospace companies. Analyzed the contractors' financial performance and viability, bankruptcy risks, potential financing sources, project cash flows, and the impact of contract termination.
- Assessed reliability of statistical study related to pricing accuracy for a large retailer. Analyzed issues related to overall study methodology, sampling bias, and quantification of harm to consumers.
- Testified in *Delaware Chancery Court in Frontier Oil Corp. v. Holly Corp.*, a merger-related dispute in the energy industry. Testimony involved the valuation of a potential environmental liability/toxic tort arising from oil and gas operations, including an assessment of the materiality of the liability to the proposed merger.
- Submitted expert testimony in government procurement litigation matter involving office productivity software. Analyzed financial costs and benefits of software standardization initiative, reviewed product comparisons, analyzed data on software installation and use, evaluated claims regarding alleged product integration and standardization advantages, and analyzed market consequences of government procurement decisions.
- Submitted expert testimony assessing the damages resulting from defamation in the travel retail industry.

- Developed a state-of-the-art microsimulation model for estimating the future liability of former asbestos manufacturers from personal injury lawsuits. Developed several financial cash-flow models to determine long-term viability of product liability settlement trusts.
- Conducted several valuation studies related to potential future product liability and potential future litigation recoveries. Valuation reports prepared and submitted as part of the acquisition process for due diligence and tax reporting purposes.
- Provided project oversight for estimation of damages in patent infringement case in the financial services industry. Damages estimated based on a reasonable royalty methodology.
- Conducted a valuation of a plaintiff's legal claims related to several ongoing major litigation matters. Valuation report submitted for tax reporting purposes.
- Analyzed the impact of a private-label credit card on a large retailer's sales and profits in a major tax dispute. Developed a robust statistical model using the company's point-of-sale data, credit card data, and customer demographic information. Tax dispute resolved in favor of the client based on this analysis.
- Conducted market and industry analyses for various due diligence, breach of contract, bankruptcy, and product liability engagements in the areas of insurance, general aviation, commercial property, electronic funds transfer, restaurant franchising, and construction.

A.6. Selected energy regulatory experience

- Submitted an affidavit on behalf of the Electric Power Supply Association in *PJM Interconnection, L.L.C.* (FERC Docket No. RM18-1314-000). Evaluated PJM's proposed modifications to its auction market rules to address market distortions caused by the participation of subsidized resources in PJM's capacity market.
- Submitted affidavit in FERC Proceeding related to Grid Reliability and Resilience Pricing (Docket No. RM18-1-000). Responded to DOE's proposal to subsidize uneconomic coal and nuclear units.
- Submitted testimony on behalf of Vote Solar in proceedings before the Public Service Commission of Utah regarding the costs and benefits of distributed solar generation. Responded to Rocky Mountain Power's proposed changes to the Utah residential Net Energy Metering (NEM) program.
- Testified on behalf of Florida Power & Light Company in proceedings before the Florida Public Service Commission regarding the potential impact on residential and commercial customers of a proposed base rate increase.
- Testified on behalf of Tenaska and Coral Power in proceedings before the Public Utility Commission of Texas (PUC Docket No. 33687) related to the application by Entergy Gulf States,

Inc., of its "Transition to Competition Plan." Analyzed issues related to Entergy's business strategy, cost-benefit analysis, cost allocation, cross-subsidization, and potential harm to competition.

- Submitted testimony on behalf of Occidental Chemical Company in FERC proceedings (Docket No. ER10-396-000) related to the application by Tres Amigas for authorization to sell transmission services at negotiated rates. Analyzed potential market power issues raised by the application.
- Submitted testimony on behalf of the NRG Companies in FERC proceedings (Docket No. ER08-1209-000) related to the proposal by ISO New England Inc. and the New England Power Pool Participants Committee to compensate rejected Dynamic and Static De-List Bids in the ISO-NE Forward Capacity Auction.
- Submitted testimony on behalf of Milford Power Company, LLC, in FERC proceedings (Docket No. ER99-4102-___) related to the Commission's generation market power screens as applicable to Milford's market-based rate authority.
- Testified on behalf of the New York Power Authority in FERC proceedings (Docket No. ER06-456-000, et al.) related to the proposal by PJM Interconnection, LLC, to allocate cost responsibility for certain transmission network upgrades included in the baseline PJM Regional Transmission Expansion Plan to merchant transmission projects that interconnect with the PJM transmission network.
- Submitted testimony on behalf of Southaven Power and Kelson Energy III in FERC proceedings (Docket No. EC08-___-000) related to potential market power issues arising from Kelson's proposed acquisition of the Southaven generation facility. Submitted testimony on behalf of Kelson Energy III in FERC Docket No. ER08-___-000 related to the Commission's generation market power screens as applicable to Kelson's application for market-based rate authority.
- Testified on behalf of Shell Trading Gas and Power Company and Calpine Corp. in proceedings before FERC (Docket Nos. ER97-4166-015, EL04-124-000, et al.) related to the application by the Southern Companies for market-based rate authority. Analyzed issues related to the appropriate implementation of the Commission's Delivered Price Test, generation market power, Southern Companies' transmission network, barriers to entry, and affiliate preferences.
- Submitted comments in proceedings before the Federal Energy Regulatory Commission (FERC) (Docket Nos. RM07-19-000 and AD07-7-000) related to "Wholesale Competition in Regions with Organized Electric Markets" (see "Comments of the Electric Power Supply Association"). Analyzed economic issues related to FERC's demand response proposals.
- Submitted testimony on behalf of Occidental Chemical Company in FERC proceedings (Docket No. EC07-70-000) evaluating the proposed acquisition of jurisdictional assets of Calcasieu Power,

LLC, by Entergy Gulf States, Inc. Analyzed issues related to the impact of the acquisition on market concentration and the ability of the applicant to exercise market power.

- Testified on behalf of the Texas Industrial Energy Consumers in proceedings before the Public Utility Commission of Texas (SOAH Docket No. 473-06-2536 and PUC Docket No. 32766) related to the retail electric power rates charged by Southwestern Public Service Company. Analyzed issues associated with the appropriate allocation of average system fuel costs and cross-subsidization.
- Testified on behalf of BP Canada Energy Marketing Corp. and IGI Resources, Corp., in FERC proceedings (Docket No. RP06-407) related to the application by Gas Transmission Northwest Corporation for market-based rate authority and flexible services rates for certain transportation services provided by the GTN natural gas pipeline.
- Testified on behalf of Occidental Permian Ltd. and Occidental Power Marketing, L.P., in FERC proceedings (Docket No. EL05-19-002 and ER05-168-001) related to the wholesale electric power rates charged by Southwestern Public Service Company. Analyzed issues associated with the appropriate allocation of average system fuel costs and cross-subsidization.
- Submitted testimony on behalf of Occidental Permian Ltd. and Occidental Power Marketing, L.P., in FERC proceedings (Docket No. ER01-FY205-009, et al.) related to the application by Southwestern Public Service Company for market-based rate authority. Analyzed issues related to generation market power and affiliate abuse.
- Submitted testimony on behalf of Calpine Corp. in FERC proceedings (Docket No. ER05-1065-000) and Louisiana Public Service Commission proceedings (Docket No. U-28155) related to the application by Entergy Services, Entergy Louisiana, and Entergy Gulf States, to establish an Independent Coordinator of Transmission. Analyzed the functions to be performed by the ICT, Entergy's transmission pricing proposal, and its Weekly Procurement Process proposal.
- Submitted testimony on behalf of Calpine Corp. in proceedings before the Louisiana Public Service Commission (Docket No. U-27836) related to the application by Entergy Louisiana, Inc., and Entergy Gulf States, Inc., for approval of the purchase of the Perryville, La., electric generating facility. Analyzed issues of market power and calculated the extent to which the proposed transaction increased market concentration.
- Submitted expert testimony on behalf of Duke Energy in response to a FERC Show Cause Order (Docket No. EL03-152-000) relating to alleged "gaming" behavior in the California power markets.
- Submitted testimony on behalf of Calpine Corp. and Occidental Chemical Corp. in FERC proceedings (Docket No. ER91-569-023) related to the application by Entergy Services for market-based rate authority. Analyzed issues of generation market power, transmission market power, barriers to entry, and affiliate abuse in the Entergy control area. Implemented a model of

the Entergy control area transmission constraints in performing the generation market power analysis.

- Submitted testimony on behalf of Calpine Corp. in FERC proceedings (Docket No. ER96-2495-018, et al.) related to the application by AEP Power Marketing, Inc., et al., for market-based rate authority. Analyzed issues of generation market power, transmission market power, barriers to entry, and affiliate abuse in the AEP-SPP control area.
- Submitted expert testimony on behalf of InterGen in FERC proceedings (Docket No. EC03-131-000) related to Oklahoma Gas & Electric's proposed acquisition of NRG McClain. Analyzed issues of horizontal and vertical market power for a hearing to identify appropriate mitigation measures.
- Submitted expert testimony on behalf of the Independent Energy Producers Association on vertical market power in FERC proceedings (Docket No. ER04-316-000) related to Southern California Edison's proposed acquisition of a Mountainview, California, electricity generating facility and a subsequent inter-affiliate Power Purchase Agreement.
- Submitted report for the Independent Energy Producers Association regarding the market price referent methodology for use in California Renewables Portfolio Standards power solicitations in proceedings before the California Public Utilities Commission (Docket No. OIR 01-10-024).
- Submitted expert testimony on behalf of Duke Energy in FERC proceedings (Docket Nos. EL00-95-075 and EL00-98-063) related to the California power markets during 2000–2001 and allegations of improper bidding behavior. Analyzed detailed data on individual bids and plant-level generation, performed statistical analysis of "physical" and "economic" capacity withholding, analyzed financial market data, examined alleged evidence of manipulative trading strategies, and assessed evidence of coordinated behavior.

A.7. Selected business consulting experience

- Assisted pharmaceutical company in assessing intellectual property-related issues as part of an acquisition, and in assessing royalties for certain intellectual property in potential licensing transactions.
- Prepared numerous transfer pricing analyses on behalf of large automotive manufacturers, used for documentation, planning, and audit on a global basis. Evaluated policies and pricing for related-party transactions with respect to the arm's length standard under US, Mexico, OECD, and other country guidelines. Analyzed transfer pricing issues related to finished vehicles, engines, transmissions, other components, royalties, and services. Developed cost-sharing arrangements; assisted in bringing consistency across documentation studies prepared for different tax jurisdictions; addressed issues related to Advance Pricing Agreements and

Competent Authority proceedings; and in audit and controversy proceedings, rebutted the transfer pricing analyses of various tax authorities.

- Submitted comments to various government agencies regarding the cost-effectiveness of biodiesel as a means of reducing CO2 emissions from transportation fuels.
- Authored a report on the US ethanol industry, quantifying the impact of the expiration of the Voluntary Ethanol Excise Tax Credit (VEETC) and a tariff on US ethanol imports.
- Estimated value of automotive engine technology for large international automotive manufacturer. Study prepared for tax and financial reporting purposes.
- Conducted numerous transfer pricing studies for tax planning, documentation, and audits. Clients include large multinational companies involved in automotive manufacturing, pharmaceutical preparations, medical products, computer software/hardware, industrial equipment, retail clothing, food products, tobacco, alcoholic and non-alcoholic beverages, oil drilling services, package delivery services, shipping, and industrial products.
- Designed, managed, and implemented intellectual property-related planning initiatives for large multinational clients in manufacturing, computer, telecommunications, and consumer product industries. Designed R&D cost sharing arrangements and prepared transfer pricing documentation for tax compliance.
- Estimated value of liabilities for a remainder trust established for a former manufacturer of food products. Potential liabilities were related to environmental remediation costs associated with a "Superfund" site containing hazardous waste.
- Managed the development of advanced data analytic software based on artificial neural networks for financial services client. Responsible for identifying new product opportunities for client, evaluating feasibility of applications, performing cost-benefit analysis for new product investment, designing implementation plan, and managing the overall software development process.
- Estimated the future asbestos liability of several companies (public and private) for investment research firms and potential acquirers as due diligence. Analyzed the litigation risks faced by the companies, insurance coverage issues, potential consequences of other developments in the asbestos litigation environment, and financial reporting issues.
- Conducted extensive empirical research on the impact of R&D and advertising on profitability; analyzed the impact of foreign exchange rate fluctuations on US prices.
- Analyzed economic issues on behalf of the Electric Power Supply Association with respect to demand response programs and price caps in organized electric markets in FERC Docket Nos. RM07-19-000 and AD07-7-000 ("Wholesale Competition in Regions with Organized Electric Markets").

- Prepared a quantitative analysis of the benefits of competitive electric wholesale markets on behalf of an energy company.
- Prepared a whitepaper on the use of competitive procurements as a means of reducing market power in wholesale electric markets on behalf of an energy company.
- Submitted a report on behalf of the Independent Energy Producers Association regarding the proposed market price referent methodology for use in the California Renewables Portfolio Standards power solicitations in proceedings before the California Public Utilities Commission (Docket No. OIR 01-10-024).
- Developed a financial simulation model for a major transportation consortium in contract negotiations with the US Department of Defense to determine the appropriate compensation for risk in a long-term supply contract.
- Managed and directed various business consulting projects requiring statistical analysis to guide pricing and marketing decisions.
- Provided strategy consulting to seed-stage start-up companies, including development of business strategy, competitive analysis, intellectual property assessment, development of revenue and cost projections, and formulation of business and financing plan.
- Conducted an antidumping study to estimate exposure to tariffs in the petrochemical industry.

A.8. Related activities and honors

- German Academic Exchange Service Grant (awarded)
- Council for European Studies Pre-Dissertation Fellowship (Columbia University)
- Dean’s University Fellowship (University of Massachusetts)
- Herbert Lehman Fellowship (New York State)

A.9. Languages

- French (fluent)
- German (fluent)
- Spanish (intermediate)

Appendix B. Materials relied upon

In addition to all materials below, I incorporate by reference all materials used or cited in footnotes and analyses.

B.1. Legal and other case documents

- 15 U.S.C. § 15 (2023)
- 18 U.S.C. § 1964 (2023)
- Alaska Stat § 45.50 (2023)
- Arkansas Code § 4-88 (2023)
- Expert Report of Douglas Skinner (July 30, 2024), backup materials and all cited documents.
- Expert Report of Jeffrey S. Andrien (June 7, 2024), backup materials and all cited documents.
- Expert Report of Jeffrey S. Andrien (September 9, 2024).
- Expert Report of John Chandler. (June 7, 2024).
- Expert Report of Joshua Gans (June 7, 2024).
- Expert Report of Matthew Weinberg (June 7, 2024).
- Expert Report of Matthew Weinberg (September 9, 2024).
- Expert Report of Steven N. Wiggins (July 30, 2024), backup materials and all cited documents.Florida Stat §§ 501.201 - 501.213 (2023)
- Idaho Code §§ 48-601 - 48-619 (2023)
- Idaho Rules of Consumer Protection (2023)
- Indiana Code § 24-5 (2023).
- Kentucky Rev Stat §§ 367.110 - 367.990 (2023)
- Laws of Puerto Rico § 259 (2023)
- Mississippi Code § 75-24 (2023)
- Missouri Rev Stat § 407 (2023)
- Montana Code § 30-14 (2023)
- Nevada Rev Stat § 598 (2023)
- North Dakota Century Code § 51-15 (2023)

- South Carolina Code § 39-5 (2023)
- South Dakota Code § 37-24 (2023)
- Utah Code § 13-11 (2023)

B.2. Books and academic papers

- Alm, James, Edward Sennoga, and Mark Skidmore. "Perfect Competition, Spatial Competition, and Tax Incidence in the Retail Gasoline Market" (Fiscal Research Center, Georgia State University, FRC Report No. 112, September 2005).
- Becker, G.S. "Crime and Punishment: An Economic Approach." *Journal of Political Economy* 76, no. 2:169 (March-April 1968).
- Borell, Joan-Ramon, Carmen García, Juan Luis Jiménez, and Jos é Manuel Ordoñez-De-Haro. "25 Years of Leniency Programs: A Turning Point in Cartel Prosecution." CPI Antitrust Chronicle, January 2019:6, available at: https://diposit.ub.edu/dspace/bitstream/2445/154157/1/693856.pdf.
- Brealey, Richard, Stewart Myers, and Franklin Allen. *Principles of Corporate Finance*, 8th ed. McGraw-Hill, 2006.
- Brick, Ivan, Oded Palmon, and John Wald. "CEO Compensation, Director Compensation, and Firm Performance: Evidence of Cronyism?" Journal of Corporate Finance 12, no. 3:403 (2006).
- Bryant, Peter and E. Woodrow Eckart. "Price Fixing: The Probability of Getting Caught." *Review of Economics and Statistics* 73, no. 3:531 (August 1991).
- Chopra, Rohit and Samuel A. A. Levine. "The case for resurrecting the FTC Act's penalty offense authority." *University of Pennsylvania Law Review*, Vol. 170: 71, 2021.
- Combe, Emmanuel, Constance Monnier, and Renaud Legal. "Cartels: the Probability of Getting Caught in the European Union" (Bruges European Economic Research Papers, paper no. 12, March 2008).
- Durlauf, Steven N. and Lawrence E. Blume, editors. *The New Palgrave Dictionary of Economics*, 2nd ed. 2008.
- Fich, Eliezer and Anil Shivdasani. "Are Busy Boards Effective Monitors?" Journal of Finance 61, no. 2:689 (2006).
- Goldfarb, Avi, Shane M. Greenstein, and Catherine E. Tucker, editors. *Economic Analysis of the Digital Economy* (Chicago: University of Chicago Press, 2015).

- Hall, Brian and Kevin Murphy. "The Trouble with Stock Options." *Journal of Economic Perspectives* 17, no. 3:49 (Summer 2003).
- Ho, K., A. Hortaçsu, and A. Lizzeri, editors. *Handbook of Industrial Organization*. Vol. 4. Elsevier, 2021.
- Holmstrom, Bengt. "Moral Hazard and Observability." Bell Journal of Economics 10, no. 1: 74 (Spring 1979).
- Jagannathan, Murali, Clifford Stephens, and Michael Weisbach. "Financial Flexibility and the Choice Between Dividends and Stock Repurchases." *Journal of Financial Economics* 57 (2000).
- Jonathan Berk and Peter DeMarzo. *Corporate Finance*, Pearson: Third Edition, 2014.
- Kim, Myongjin, Qihong Liu, and Nicholas G. Rupp. "When Do Firms Offer Higher Product Quality? Evidence from the Allocation of Inflight Amenities." *Review of Industrial Organization* 62 (2023). https://doi.org/10.1007/s11151-022-09892-9.
- Lancieri, Filippo, Eric Posner, and Luigi Zingales. "The Political Economy of the Decline of Antitrust Enforcement in the United States." *Antitrust Law Journal* 85, no. 2:441 (2023).
- Lande, Robert H. "Are Antitrust "Treble" Damages Really Single Damages." 54 Ohio St. L.J. 115 (1993).
- Landes, W.M. "Optimal Sanctions for Antitrust Violations." *The University of Chicago Law Review* 50, no. 2: 652 (1983).
- Peitz, Martin and Yossi Spiegel, editors. *The Analysis of Competition Policy and Sectoral Regulation*. Vol. 4. August 2014. https://doi.org/10.1142/9228.
- Polinsky, A. Mitchell and Steven Shavell, editors. *The Handbook of Law and Economics*, 1st ed. 2006.
- Polinsky, A. Mitchell and Steven Shavell. "The Economic Theory of Public Enforcement of Law." *Journal of Economic Literature* 38:45 (March 2000).
- Rochet, J.-C. and J. Tirole. "Two-sided markets: a progress report." RAND Journal of Economics 37, no. 3:645 (Autumn 2006).
- Salop, Steven and Lawrence J. White. "Economic Analysis of Private Antitrust Litigation." 74 GEO. L.J. 1001, 1051 (1986).
- Shah, Sunit. "The Principal-Agent Problem in Finance." CFA Institute Research Foundation L2014-1, March 1, 2014. Available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2574742.
- Srinivasan, Dina. "Why Google Dominates Adveritising Markets: Competition Policy Should Lean on the Principles of Financial Market Regulation." Stanford Technology Law Review 24:56 (2020).

- Thurman Arnold Project. "Modern Antitrust Enforcement." Yale School of Management. https://som.yale.edu/centers/thurman-arnold-project-at-yale/modern-antitrust-enforcement.
- Weil, Roman L., Daniel G. Lentz, and David P. Hoffman, eds. Litigation Services Handbook: The Role of the Financial Expert. 5th ed. Hoboken, NJ Wiley, 2012.
- Werden, Gregory and Marilyn Simon. "Why Price Fixers Should Go To Prison." *Antitrust Bulletin* 32, no.4:917 (Winter 1997).
- Wils, Wouter. "Optimal Antitrust Fines: Theory and Practice." *World Competition* 29, no. 2 (June 2006).

B.3. SEC filings

- Alphabet Inc. *Form 10-K 2015*. February 11, 2016.
- Alphabet Inc. *Form 10-K 2016*. February 3, 2017.
- Alphabet Inc. *Form 10-K 2017*. February 6, 2018.
- Alphabet Inc. *Form 10-K 2018*. February 5, 2019.
- Alphabet Inc. *Form 10-K 2019*. February 4, 2020.
- Alphabet Inc. *Form 10-K 2020*. February 3, 2021.
- Alphabet Inc. *Form 10-K 2021*. February 2, 2022.
- Alphabet Inc. *Form 10-K 2022*. February 3, 2023.
- Alphabet Inc. *Form 10-K 2023*. January 30, 2024.
- Alphabet Inc. Schedule 14A, June 7, 2024.

B.4. Websites, articles, and press releases

- "AdMob vs. Google Ad Manager. Which One Is Better?" Ad Plus. Accessed August 30, 2024. https://blog.ad.plus/google-ad-manager-vs-admob/.
- "Advertising with Google Ad Manager." Google Ad Manager Help. Accessed 30, 2024. https://support.google.com/admanager/answer/6022000?hl=en.
- "Combatting the Youth Vaping Epidemic by Enhancing Enforcement against Illegal E-Cigarettes." Testimony of Brian A. King before the Committee on the Judiciary, United States Senate, June 12, 2024. https://www.fda.gov/media/179312/download?attachment.

- "Compare Ad Manager, AdSense, and AdMob." Google Ad Manager Help. Accessed August 21, 2024. https://support.google.com/admanager/answer/9234653?hl=en.
- "Google Network." Google Ads Help. Accessed September 5, 2024. https://support.google.com/google-ads/answer/1752334?hl=en.
- "Martin Pál." Google Research. Accessed September 4, 2024. https://research.google/people/author20/?&.
- "Max Loubser." LinkedIn. Accessed September 4, 2024. https://www.linkedin.com/in/maxloubser/.
- "The Google Network." Google Ads Help. Accessed September 4, 2024. https://support.google.com/google-ads/answer/1721923?sjid=5862812278570074634-NA.
- "The Inspector General's Statement on the SEC's Management and Performance Challenges." U.S. Securities and Exchange Commission, 2023. Accessed September 1, 2024. https://www.sec.gov/files/inspector-generals-statement-sec-mgmt-and-perf-challenges-october-2023.pdf.
- “Google falls on share plan.” Financial Post, April 13, 2012, https://financialpost.com/news/google-falls-on-share-plan.
- 50pros. "Fortune 500 Full List (2024)." Accessed September 4, 2024. https://www.50pros.com/fortune500.
- Alphabet Inc. Q1 2024 Earnings Call. April 25, 2024.
- Alphabet Inc. Q3 2015 Earnings Call. October 22, 2015.
- Alphabet Inc. Q3 2016 Earnings Call. October 27, 2016.
- Anderson, Elizabeth, Patrick McNally, Sameer Patel, and Joanna Zhou. "Get with the Program(matic)!." Evercore ISI, Flash Note, Healthcare Technology & Distribution. August 24, 2023.
- Arizona State Office of the Attorney General. "Attorney General Mark Brnovich Achieves Historic $85 Million Settlement with Google." News release, October 4, 2022, https://www.azag.gov/press-release/attorney-general-mark-brnovich-achieves-historic-85-million-settlement-google#:~:text=Attorney%20General%20Mark%20Brnovich%20Achieves%20Historic%20%2485%20Million%20Settlement%20with%20Google,-Tuesday%2C%20October%204&text=PHOENIX%20%E2%80%93%20Attorney%20General%20Mark%20Brnovich,billions%20of%20dollars%20in%20profit.
- Associated Press. "German price platform sues Google over search results." April 12, 2019, https://apnews.com/international-news-general-news-744586e7278645bba829e81adf8ad9a6.

- Australian Competition & Consumer Commission. "Google allegedly misled consumers on collection and use of location data." News release, October 29, 2019, https://www.accc.gov.au/media-release/google-misled-consumers-about-the-collection-and-use-of-location-data.
- Australian Competition & Consumer Commission. "Google LLC to pay $60 million for misleading representations." News release, August 12, 2022, https://www.accc.gov.au/media-release/google-llc-to-pay-60-million-for-misleading-representations.
- Autorité de la Concurrence. "Decision 21-D-11 of June 07, 2021." News release, July 26, 2021, https://www.autoritedelaconcurrence.fr/sites/default/files/attachments/2021-07/21-d-11_ven.pdf.
- "Autorité de la Concurrence. ""Related rights: the Autorité fines Google €250 million for non-compliance with some of
- its commitments made in June 2022."" News release, March 20, 2024, https://www.autoritedelaconcurrence.fr/en/press-release/related-rights-autorite-fines-google-eu250-million-non-compliance-some-its."
- Autorité de la Concurrence. "Renumeration of related rights for press publishers and agencies: the Autorité fines Google up to 500 million euros for non-compliance with several injunctions." News release, July 13, 2021, https://www.autoritedelaconcurrence.fr/en/communiques-de-presse/remuneration-related-rights-press-publishers-and-agencies-autorite-fines#:~:text=In%20a%20decision%20issued%20today,des%20%C3%A9diteurs%20de%20la%20presse.
- Balderas v. Google LLC, 489 F. Supp. 3d 1254 (D.N.M. 2020).
- BBC. "Google fined £91m over ad-tracking cookies." December 10, 2020, https://www.bbc.com/news/technology-55259602.
- BBC. "Google fined over illegal wi-fi data capture in Germany." April 22, 2013, https://www.bbc.com/news/technology-22252506.
- Bellack, Jonathan. "Introducing Google Ad Manager." Google Ad Manager. June 27, 2018. https://blog.google/products/admanager/introducing-google-ad-manager/.
- Board of Governors of the Federal Reserve System. "Foreign Exchange Rates - H.10," Series Historical Rates for the Australian Dollar, https://www.federalreserve.gov/releases/h10/hist/dat00_al.htm. Accessed August 28, 2024.
- Board of Governors of the Federal Reserve System. "Foreign Exchange Rates - H.10," Series Historical Rates for the EU Euro, https://www.federalreserve.gov/Releases/H10/hist/dat00_eu.htm. Accessed August 28, 2024.

- Boring v. Google, No. 09-2350, (3rd Cir. January 25, 2010).
- Brian, Matt. "France slaps Google with $204,000 fine for violating privacy laws." Engadget, January 8, 2014, https://www.engadget.com/2014-01-08-google-privacy-cnil-fine.html?guccounter=1&guce_referrer=aHR0cHM6Ly93d3cuZ29vZ2xlLmNvbS8&guce_referrer_sig=AQAAACS5qmVckgkOrJv9Ksr6TwmCzuYrre4K07HbPfEGcNapV0oFxjWMxwekms8Xzu440CjYOwAV0zJhSsYD1NfjdljNgWVSdz6L4-1cvcOHIs6v9TGw22QMDBpxZcxqsBEGBAG3tXO62bvQmt9hX9Khksext4hO5rSgxwaioiV6KhZL.
- Capoot, Ashley. "Alphabet just had its worst day since March 2020, when Covid shutdowns started in the U.S." CNBC, October 26, 2022, https://www.cnbc.com/2022/10/26/alphabet-stock-falls-after-disappointing-earnings-report.html.
- Chan, Kelvin. "Google loses appeal of huge EU fine over shopping searches." AP News, November 10, 2021, https://apnews.com/article/business-european-union-european-commission-europe-euro-b7baf101cacca2f1a6d21faba5a7b91e.
- CMS. "GDPR Enforcement Tracker - list of GDPR fines - ETid-1176." https://www.enforcementtracker.com/ETid-1176.
- CMS. "GDPR Enforcement Tracker - list of GDPR fines - ETid-23." https://www.enforcementtracker.com/ETid-23. Accessed August 20, 2024.
- CMS. "GDPR Enforcement Tracker - list of GDPR fines - ETid-232." https://www.enforcementtracker.com/ETid-232.
- CMS. "GDPR Enforcement Tracker - list of GDPR fines - ETid-344." https://www.enforcementtracker.com/ETid-344.
- "Commission Nationale de l'Informatique et des Libertés. ""Deliberation of the Restricted Committee n° SAN-2020-012 of 7 December 2020 concerning GOOGLE LLC and GOOGLE IRELAND
- LIMITED."" News release, December 7, 2020, https://www.cnil.fr/sites/cnil/files/atoms/files/deliberation_of_restricted_committee_san-2020-012_of_7_december_2020_concerning_google_llc_and_google_ireland_limited.pdf."
- Competition Commission of India. "PRESS RELEASE No. 55/2022-23." News release, October 20, 2022, https://www.cci.gov.in/antitrust/press-release/details/261/0.
- Competition Commission of India. "PRESS RELEASE No. 56/2022-23." News release, October 25, 2022, https://cci.gov.in/images/pressrelease/en/pr-no-562022-231666698260.pdf.
- Complaint. Google LLC and iHeartMedia, Inc. FTC File Number 2023092. https://www.ftc.gov/system/files/ftc_gov/pdf/2022-07-20%20Complaint.pdf.

- Davies, Richard. "Google's Stock Split Surprise." ABC News, April 13, 2012, https://abcnews.go.com/blogs/business/2012/04/googles-stock-split-surprise.
- U.S. Department of Justice. "Google Forfeits $500 Million Generated by Online Ads & Prescription Drug Sales by Canadian Online Pharmacies." News release no. 11-1078, August 24, 2011, https://www.justice.gov/opa/pr/google-forfeits-500-million-generated-online-ads-prescription-drug-sales-canadian-online.
- Economic Times. "South Korea to fine Google USD 177 Million for forcing software on devices." September 14, 2021, https://economictimes.indiatimes.com/news/international/business/south-korea-to-fine-google-usd-177-million-for-forcing-software-on-devices/articleshow/86196629.cms.
- EDRi. "Google was fined by French and Spanish Data Protection Authorities." January 15, 2014, https://edri.org/our-work/google-fined-french-spanish-data-protection-authorities/.
- Epic. "Investigations of Google Street View." Accessed August 29, 2024. https://epic.org/documents/investigations-of-google-street-view/.
- European Commission. "Antitrust: Commission fines Google €1.49 billion for abusive practices in online advertising." News release, March 20, 2019, https://ec.europa.eu/commission/presscorner/detail/en/IP_19_1770.
- European Commission. "Antitrust: Commission fines Google €2.42 billion for abusing dominance as search engine by giving illegal advantage to own comparison shopping service." News release, June 27, 2017, https://ec.europa.eu/commission/presscorner/detail/en/IP_17_1784.
- European Commission. "Antitrust: Commission fines Google €4.34 billion for abuse of dominance regarding Android devices." News release, July 18, 2018, https://ec.europa.eu/commission/presscorner/detail/en/IP_18_4581
- European Commission. "Antitrust: Commission opens formal investigation against Google in relation to Android mobile operating system." News release, April 15, 2015, https://ec.europa.eu/commission/presscorner/detail/it/MEMO_15_4782.
- European Commission. "Antitrust: Commission probes allegations of antitrust violations by Google." News release, November 30, 2010, https://ec.europa.eu/commission/presscorner/detail/en/IP_10_1624.
- European Commission. "Antitrust: Commission sends Statement of Objections to Google over abusive practices in online advertising technology." News release, June 14, 2023, https://ec.europa.eu/commission/presscorner/detail/en/IP_23_3207.
- European Data Protection Board. "The CNIL's restricted committee imposes a financial penalty of 50 Million euros against GOOGLE LLC." News release, January 21, 2019,

https://www.edpb.europa.eu/news/national-news/2019/cnils-restricted-committee-imposes-financial-penalty-50-million-euros_en.

- Federal Antimonopoly Service of the Russian Federation. "'Google' abuses its dominant position on the market of pre-installed application stores in 'Android' OS." News release, September 14, 2015, https://en.fas.gov.ru/press-center/news/detail.html?id=39482.
- Federal Reserve Board. "SEP: Compilation and Summary of Individual Economic Projections," June 18-19, 2013, 1, https://www.federalreserve.gov/monetarypolicy/files/FOMC20130619SEPcompilation.pdf.
- Federal Trade Commission. "FTC Approves Final Orders against Google and iHearMedia for Deceptive On-Air Endorsements for Google's Pixel 4 Phone." News release, February 9, 2023, https://www.ftc.gov/news-events/news/press-releases/2023/02/ftc-approves-final-orders-against-google-iheartmedia-deceptive-air-endorsements-googles-pixel-4.
- Federal Trade Commission. "Google LLC and YouTube, LLC." Cases and Proceedings. Accessed August 21, 2024. https://www.ftc.gov/legal-library/browse/cases-proceedings/172-3083-google-llc-youtube-llc.
- Federal Trade Commission. "Google Will Pay $22.5 Million to Settle FTC Charges it Misrepresented Privacy Assurances to Users of Apple's Safari Internet Browser." News release, August 9, 2012, https://www.ftc.gov/news-events/news/press-releases/2012/08/google-will-pay-225-million-settle-ftc-charges-it-misrepresented-privacy-assurances-users-apples.
- Fioretti, Julia. "France fines Google over 'right to be forgotten.'" Reuters, March 24, 2016, https://www.reuters.com/article/technology/france-fines-google-over-right-to-be-forgotten-idUSKCN0WQ1WW/.
- Fung, Brian and Clare Duffy. "Google has an illegal monopoly on search, judge rules. Here's what's next." CNN, August 6, 2024, https://www.cnn.com/2024/08/05/business/google-loses-antitrust-lawsuit-doj/index.html.
- Gans, Jared. "Google to pay $29.5 million to settle DC, Indiana lawsuits over location tracking." Hill, December 31, 2022, https://thehill.com/policy/technology/3794301-google-to-pay-29-5-million-to-settle-dc-indiana-lawsuits-over-location-tracking/.
- Hern, Alex and Lisa O'Carroll. "EU regulator orders Google to sell part of ad-tech business." Guardian, June 14, 2023, https://www.theguardian.com/technology/2023/jun/14/eu-regulator-google-sell-ad-tech-business-competition-commission.
- In re Matrimony.com Limited and In re Consumer Unity & Trust Society (CUTS). CCI Case No. 07 and 30/2012. https://www.cci.gov.in/images/antitrustorder/en/07-and-3020121652434133.pdf.
- Indiana State Office of the Attorney General. "Attorney General Todd Rokita secures $20 million settlement with Google under same Indiana law being used against TikTok." News release,

December 29, 2022, https://events.in.gov/event/attorney_general_todd_rokita_secures_20_million_settlement_with_google_under_same_indiana_law_being_used_against_tiktok.

- Intellinews. "Turkey fines Google $16mn for violating competition rules." February 16, 2020, https://www.intellinews.com/turkey-fines-google-16mn-for-violating-competition-rules-176710/.
- Investopedia. "What Does the S&P 500 Index Measure and How Is It Calculated?" Accessed September 6, 2024. https://www.investopedia.com/ask/answers/040215/what-does-sp-500-index-measure-and-how-it-calculated.asp.
- Jordans, Frank. "Tagged in a photo without consent? Europe watchdogs take up fight; regulators' probes set the stage for battle with Facebook, Google over protecting users' rights." Mercury News, March 25, 2010, https://www.mercurynews.com/2010/11/30/european-authorities-investigating-whether-google-gave-its-services-search-preference/.
- Kades, Michael. "The State of U.S. Federal Antitrust Enforcement." Washington Center for Equitable Growth. September 17, 2019. https://equitablegrowth.org/research-paper/the-state-of-u-s-federal-antitrustenforcement/?longform=true.
- Kang, Cecilia. "Google Agrees to $392 Million Privacy Settlement With 40 States." New York Times. November 14, 2022. https://www.nytimes.com/2022/11/14/technology/google-privacy-settlement.html.
- Kim, Heejin. "South Korea Fines Google $32 Million for Squeezing Local Rival." Time, April 11, 2023, https://time.com/6270351/south-korea-fines-google-play-store/.
- Konnath, Hailey. "New Mexico Says Google Is Collecting Kids' Personal Data." Law360, February 20, 2020, https://www.law360.com/articles/1245816/new-mexico-says-google-is-collecting-kids-personal-data.
- L'Autorità Garante della Concorrenza e del Mercato. "A529 - ICA: Google fined over 100 million for abuse of dominant position." News release, May 13, 2021, https://en.agcm.it/en/media/press-releases/2021/5/A529.
- "L'Autorità Garante della Concorrenza e del Mercato. ""PS11147-PS11150 - ICA: $20 million sanctions against Google and Apple for commercial use of
- user data."" News release, November 26, 2021, https://en.agcm.it/en/media/press-releases/2021/11/PS11147-PS11150."
- Library of Congress. "France: Google Fined by National Commission on Information Technology and Liberty." News release, March 25, 2011, https://www.loc.gov/item/global-legal-monitor/2011-03-25/france-google-fined-by-national-commission-on-information-technology-and-liberty/.

- Library of Congress. "Turkey: Competition Authority Fines Google and Subsidiaries for Abuse of Market Dominance." News release, December 8, 2020, https://www.loc.gov/item/global-legal-monitor/2020-12-08/turkey-competition-authority-fines-google-and-subsidiaries-for-abuse-of-market-dominance/.
- Lomas, Natasha. "France spanks Google $170M, Facebook $68M over cookie consent dark patterns." TechCrunch, January 6, 2022, https://techcrunch.com/2022/01/06/cnil-facebook-google-cookie-consent-eprivacy-breaches/.
- Lomas, Natasha. "Google Pays Another Tiny Fine In Europe — $1.4M — For Street View Privacy Concerns." TechCrunch, April 4, 2014, https://techcrunch.com/2014/04/04/google-street-view-fine/.
- Miller, Claire Cain. "Google to Pay $17 Million to Settle Privacy Case." New York Times, November 18, 2013, https://www.nytimes.com/2013/11/19/technology/google-to-pay-17-million-to-settle-privacy-case.html.
- Mitsubishi Motor Corp. v. Soler Chrysler-Plymouth, Inc. 473 U.S. 614, 635.
- Moody's. "Alphabet Inc. LT Issuer Ratings & Assessments." Accessed August 29, 2024. https://www.moodys.com/credit-ratings/Alphabet-Inc-credit-rating-824906971/ratings/view-by-class.
- Moody's. "Rating Scale and Definitions." Accessed September 4, 2024. https://www.moodys.com/sites/products/productattachments/ap075378_1_1408_ki.pdf.
- Netherlands Authority for Consumers and Markets. "Summary of decision on abuse of dominant position by Apple." August 24, 2021. https://www.acm.nl/sites/default/files/documents/summary-of-decision-on-abuse-of-dominant-position-by-apple.pdf.
- New York State Office of the Attorney General. "Attorney General James Files Second Antitrust Lawsuit in Six Months to End Google's Illegal Monopolies." News release, July 7, 2021, https://ag.ny.gov/press-release/2021/attorney-general-james-files-second-antitrust-lawsuit-six-months-end-googles.
- News York State Office of the Attorney General. "Attorney General James and Multistate Coalition Secure $700 Million from Google for Harming Consumers." News release, December 19, 2023, https://ag.ny.gov/press-release/2023/attorney-general-james-and-multistate-coalition-secure-700-million-google#:~:text=NEW%20YORK%20%E2%80%93%20New%20York%20Attorney,for%20consumers%20and%20app%20developers.
- Notice of Apparent Liability. In re Google Inc. FCC No. DA-12-592. https://docs.fcc.gov/public/attachments/DA-12-592A1.pdf.

- Olson, Emily. "Google shares drop $100 billion after its new AI chatbot makes a mistake." NPR, February 9, 2023, https://www.npr.org/2023/02/09/1155650909/google-chatbot--error-bard-shares.
- Pepitone, Julianne. "Stocks end November with a whimper." CNN Money, November 30, 2010, https://money.cnn.com/2010/11/30/markets/markets_newyork/index.htm.
- Reid, David. "EU regulators hit Google with $1.7 billion fine for blocking ad rivals." CNBC, March 20, 2019, https://www.cnbc.com/2019/03/20/eu-vestager-hits-google-with-fine-for.html.
- Reuters. "Dutch regulator rejects Apple's objections to fines." October 2, 2023, https://www.reuters.com/technology/dutch-regulator-rejects-apples-objections-against-fines-2023-10-02/.
- Richards, Matt. "Google hit by Android fine in Turkey." GCR, September 21, 2018, https://globalcompetitionreview.com/article/google-hit-android-fine-in-turkey.
- Satariano, Adam. "E.U. Scores Major Legal Victory Against Google." New York Times, September 14, 2022, https://www.nytimes.com/2022/09/14/business/eu-google-antitrust-fine.html#:~:text=The%20fine%20of%204.34%20billion,leadership%20of%20its%20search%20engine.
- State ex rel. Wilson v. Ortho-McNeil-Janssen Pharm., Inc. 777 S.E.2d 176, 203 (S.C. 2015).
- Statista. "Projected annual inflation rate in the United States from 2010 to 2029." April 2024. https://www.statista.com/statistics/244983/projected-inflation-rate-in-the-united-states/.
- Statista. “The 100 largest companies in the world by market capitalization in 2023.” https://www.statista.com/statistics/263264/top-companies-in-the-world-by-market-capitalization/. Accessed September 4, 2024.
- Stempel, Jonathan. "Google to pay $155 million in settlements over location tracking." Reuters, September 15, 2023, https://www.reuters.com/legal/google-pay-155-million-settlements-over-location-tracking-2023-09-15/#:~:text=Sept%2015%20(Reuters)%20%2D%20Google,that%20the%20Alphabet%20Inc%20(GOOGL.
- Texas Deceptive Trade Practices Act. Accessed May 29, 2024. https://statutes.capitol.texas.gov/Docs/BC/htm/BC.17.htm.
- Twin Cities. "EU sets up antitrust probe of how Google works." November 12, 2015, https://www.twincities.com/2010/11/30/eu-sets-up-antitrust-probe-of-how-google-works/
- U.S. Department of Justice. "Justice Department Sues Google for Monopolizing Digital Advertising Technologies." News release no. 23-84, January 24, 2023,

https://www.justice.gov/opa/pr/justice-department-sues-google-monopolizing-digital-advertising-technologies.

- Waem, Heidi. "Belgian DPA imposes a EUR600,000 fine, its highest fine ever, on Google Belgium for non-compliance with right to be forgotten." DLA Piper, July 16, 2020, https://www.dlapiper.com/en/insights/publications/2020/07/google-belgium-fined-by-belgian-dpa-for-non-compliance.
- Washington State Office of the Attorney General. "AG Ferguson files campaign finance lawsuits against Facebook, Google." News release, June 4, 2018, https://www.atg.wa.gov/news/news-releases/ag-ferguson-files-campaign-finance-lawsuits-against-facebook-google.
- Washington State Office of the Attorney General. "Washingtonian Google Play Store users eligible for share of $700 million as a result of AG Ferguson lawsuit." News release, December 19, 2023, https://www.atg.wa.gov/news/news-releases/washingtonian-google-play-store-users-eligible-share-700-million-result-ag#:~:text=As%20a%20result%20of%20the,to%20be%20distributed%20to%20Washingtonians.Data

B.5. Data

- Bloomberg.
- S&P Capital IQ.

B.6. Depositions

- Deposition of Nirmal Jayaram, April 26, 2024.
- Deposition of Nirmal Jayaram, July 10, 2024.
- Deposition of Nitish Korula, May 3, 2024.

B.7. Bates numbered documents

- FBDOJGOOG_01186933.
- GOOG-AT-MDL-B-001114919.
- GOOG-AT-MDL-B-004435235.
- GOOG-DOJ-28385887.

- GOOG-DOJ-29803801.
- GOOG-DOJ-32280412.
- GOOG-DOJ-AT-00221276.
- GOOG-DOJ-AT-01510462.
- GOOG-NE-03872763.
- GOOG-NE-04421287.
- GOOG-NE-04597999.
- GOOG-NE-05047199.
- GOOG-NE-07249237.
- GOOG-NE-09556461.
- GOOG-NE-11275306
- GOOG-NE-13234466.
- GOOG-TEX-00635680.GOOG-TEX-00831090.

Appendix C. Materials Considered

C.1. Pleadings

- The live pleadings (complaint and answer) within the matter of The State of Texas, et al. v. Google, Case Number: 4:20-cv-00957-SDJ, including the Fourth Amended Complaint.

C.2. Discovery responses

All available discovery responses produced within the matter of The State of Texas, et al. v. Google, Case Number: 4:20-cv-00957-SDJ, including:

- The Parties' amended initial disclosures;
- The Parties' discovery responses and objections to Interrogatories, Requests for Admission, and Requests for Production; and
- Google's written responses to Plaintiffs' Rule 30(b)(6) Notice.

C.3. Deposition transcripts & exhibits

All available deposition transcripts and exhibits within the matter of The State of Texas, et al. v. Google, Case Number: 4:20-cv-00957-SDJ, including:

- Deposition and Exhibits of [redacted]
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All available deposition transcripts and exhibits within the matter of USA v. Google, Case Number: 1:23-cv-00108-LMB-JFA, including:

- Deposition and Exhibits of [redacted]
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All available deposition transcripts and exhibits within the matter of *In re: Google Digital Advertising Antitrust Litigation*, Case Number: 1:21-md-03010-PKC, including the depositions and exhibits of:

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Other available deposition transcripts and exhibits, including the depositions and exhibits of:

[redacted]

[redacted]

C.4. Expert reports & declarations

All available expert reports, including appendices, backup materials, and cited materials, within the matter of The State of Texas, et al. v. Google, Case Number: 4:20-cv-00957-SDJ, including:

- 2024.06.07 Expert Report of Jeffrey S. Andrien
- 2024.06.07 Expert Report of Joshua Gans, as well as 2024.07.24 Errata and Supplemental Appendix D
- 2024.06.07 Expert Report of Jacob Hostetler

- 2024.06.07 Expert Report of John Chandler
- 2024.06.07 Expert Report of Matthew Weinberg
- 2024.06.07 Expert Report of Parag Pathak
- 2024.07.30 Expert Report of Anindya Ghose
- 2024.07.30 Expert Report of Donna L. Hoffman
- 2024.07.30 Expert Report of Douglas Skinner
- 2024.07.30 Expert Report of Itamar Simonson
- 2024.07.30 Expert Report of Martin C. Rinard
- 2024.07.30 Expert Report of Paul R. Milgrom
- 2024.07.30 Expert Report of Steven N. Wiggins
- 2024.08.06 Expert Report of Michael R. Baye
- 2024.08.06 Expert Report of Jason Nieh

All available expert reports (with redactions) within the matter of USA v. Google, Case Number: 1:23-cv-00108-LMB-JFA, including:

- Declarations of Google Employees
- 2023.12.22 Expert Report of Gabriel Weintraub, GOOG-AT-MDL-C-000018734
- 2023.12.22 Expert Report of R. Ravi, GOOG-AT-MDL-C-000019017
- 2023.12.22 Expert Report of Robin S. Lee, GOOG-AT-MDL-C-000019273
- 2023.12.22 Expert Report of Rosa Abrantes-Metz, GOOG-AT-MDL-C-000019786
- 2023.12.22 Expert Report of Thomas S. Respess, GOOG-AT-MDL-C-000020106
- 2023.12.22 Expert Report of Timothy Simcoe, GOOG-AT-MDL-C-000020274
- 2024.01.13 Errata to Abrantes-Metz Expert Report, GOOG-AT-MDL-C-000020435
- 2024.01.13 Errata to Ravi Expert Report, GOOG-AT-MDL-C-000020437
- 2024.01.13 Errata to Respess Expert Report, GOOG-AT-MDL-C-000020440
- 2024.01.13 Errata to Simcoe Expert Report, GOOG-AT-MDL-C-000020467
- 2024.01.13 Errata to Weintraub Expert Report, GOOG-AT-MDL-C-000020471
- 2024.01.23 Chevalier Expert Report, GOOG-AT-MDL-C-000020474

- 2024.01.23 Ferrante Expert Report, GOOG-AT-MDL-C-000020714
- 2024.01.23 Ghose Expert Report, GOOG-AT-MDL-C-000020767
- 2024.01.23 Israel Expert Report, GOOG-AT-MDL-C-000021036
- 2024.01.23 Milgrom Expert Report, GOOG-AT-MDL-C-000021794
- 2024.01.23 Rinard Expert Report, GOOG-AT-MDL-C-000022191
- 2024.01.23 Shirky Expert Report, GOOG-AT-MDL-C-000022229
- 2024.01.23 Simonson Expert Report, GOOG-AT-MDL-C-000022290
- 2024.01.23 Skinner Expert Report, GOOG-AT-MDL-C-000022948
- 2024.02.13 Expert Rebuttal Report of Adoria Lim, GOOG-AT-MDL-C-000023002
- 2024.02.13 Expert Rebuttal Report of Gabriel Weintraub, GOOG-AT-MDL-C-000023226
- 2024.02.13 Expert Rebuttal Report of Kenneth Wilbur, GOOG-AT-MDL-C-000023322
- 2024.02.13 Expert Rebuttal Report of R. Ravi, GOOG-AT-MDL-C-000023435
- 2024.02.13 Expert Rebuttal Report of Robin S. Lee, GOOG-AT-MDL-C-000023516
- 2024.02.13 Expert Rebuttal Report of Rosa Abrantes-Metz, GOOG-AT-MDL-C-000023887
- 2024.02.13 Expert Rebuttal Report of Timothy Simcoe, GOOG-AT-MDL-C-000024064
- 2024.02.13 Expert Rebuttal Report of Wayne Hoyer, GOOG-AT-MDL-C-000024138
- 2024.02.13 Expert Rebuttal Report of Wenke Lee, GOOG-AT-MDL-C-000024270
- 2024.02.16 Errata to Ravi Rebuttal Report, GOOG-AT-MDL-C-000024387
- 2024.02.20 Errata to Simcoe Rebuttal Report, GOOG-AT-MDL-C-000024389
- 2024.02.23 Errata to Weintraub Rebuttal Report, GOOG-AT-MDL-C-000024390
- 2024.02.23 Supplemental Errata to Weintraub Expert Report, GOOG-AT-MDL-C-000024391
- 2024.02.24 Errata to Wilbur Rebuttal Report, GOOG-AT-MDL-C-000024392
- 2024.02.26 Errata to Hoyer Rebuttal Report, GOOG-AT-MDL-C-000024397
- 2024.02.28 Errata to Abrantes-Metz Rebuttal Report, GOOG-AT-MDL-C-000024399
- 2024.03.04 Expert Supplemental Report of Robin S. Lee, GOOG-AT-MDL-C-000024403
- 2024.03.08 Consolidated Errata to Lee Rebuttal Report, GOOG-AT-MDL-C-000024436
- 2024.01.13 Expert Report of Weintraub Errata, GOOG-AT-MDL-C-000040965
- 2024.01.13 Expert Report of Simcoe Errata, GOOG-AT-MDL-C-000040961

- 2024.01.13 Expert Report of Respess Errata_with Figure Errata_Redacted, GOOG-AT-MDL-C-000040934
- 2024.01.13 Expert Report of R Ravi Errata, GOOG-AT-MDL-C-000040931
- 2024.01.13 Expert Report of Abrantes-Metz Errata, GOOG-AT-MDL-C-000040929
- 2024.03.08 Consolidated Errata to Lee Rebuttal Report, GOOG-AT-MDL-C-000040926
- 2024.03.04 Expert Supplemental Report of Robin S. Lee, PhD, GOOG-AT-MDL-C-000040893
- 2024.02.28 Rebuttal Report Errata of Rosa Abrantes-Metz Signed, GOOG-AT-MDL-C-000040889
- 2024.02.25 Expert Rebuttal Report of Hoyer Errata, GOOG-AT-MDL-C-000040887
- 2024.02.24 Wilbur Rebuttal Errata, GOOG-AT-MDL-C-000040882
- 2024.02.23 Weintraub Rebuttal Report Errata, GOOG-AT-MDL-C-000040881
- 2024.02.23 Expert Report of Weintraub Supplemental Errata, GOOG-AT-MDL-C-000040880
- 2024.02.20 Errata to Simcoe Rebuttal Report, GOOG-AT-MDL-C-000040879
- 2024.02.16 Errata to Ravi Rebuttal Report (Highly Confidential), GOOG-AT-MDL-C-000040877
- 2024.02.13 Rebuttal Report of Rosa Abrantes-Metz, GOOG-AT-MDL-C-000040700
- 2024.02.13 Expert Report of Wenke Lee, GOOG-AT-MDL-C-000040583
- 2024.02.13 Expert Rebuttal Report of Wayne Hoyer, GOOG-AT-MDL-C-000040451
- 2024.02.13 Expert Rebuttal Report of Timothy Simcoe_Redacted, GOOG-AT-MDL-C-000040377
- 2024.02.13 Expert Rebuttal Report of Robin S. Lee_Redacted, GOOG-AT-MDL-C-000040006
- 2024.02.13 Expert Rebuttal Report of R Ravi, GOOG-AT-MDL-C-000039925
- 2024.02.13 Expert Rebuttal Report of Kenneth Wilbur_Redacted, GOOG-AT-MDL-C-000039812
- 2024.02.13 Expert Rebuttal Report of Gabriel Weintraub_Redacted, GOOG-AT-MDL-C-000039716
- 2024.02.13 Expert Rebuttal Report of Adoria Lim_Redacted, GOOG-AT-MDL-C-000039492
- 2024.01.23 Expert Report of William Clay Shirky, GOOG-AT-MDL-C-000039431
- 2024.01.23 Expert Report of Paul R. Milgrom, GOOG-AT-MDL-C-000039034
- 2024.01.23 Expert Report of Martin C. Rinard, GOOG-AT-MDL-C-000038996
- 2024.01.23 Expert Report of Mark A. Israel_Redacted, GOOG-AT-MDL-C-000038238
- 2024.01.23 Expert Report of Judith A. Chevalier_Redacted, GOOG-AT-MDL-C-000037998
- 2024.01.23 Expert Report of Itamar Simonson, GOOG-AT-MDL-C-000037340
- 2024.01.23 Expert Report of Douglas Skinner, GOOG-AT-MDL-C-000037286

- 2024.01.23 Expert Report of Anthony J. Ferrante, GOOG-AT-MDL-C-000037233
- 2024.01.23 Expert Report of Anindya Ghose_Redacted, GOOG-AT-MDL-C-000036954
- 2023.12.22 Expert Report of Timothy Simcoe_Redacted, GOOG-AT-MDL-C-000036793
- 2023.12.22 Expert Report of Thomas Respess_Redacted, GOOG-AT-MDL-C-000036625
- 2023.12.22 Expert Report of Rosa Abrantes-Metz_Redacted, GOOG-AT-MDL-C-000036305
- 2023.12.22 Expert Report of Robin S. Lee, PhD_Redacted, GOOG-AT-MDL-C-000035792
- 2023.12.22 Expert Report of R Ravi_Redacted, GOOG-AT-MDL-C-000035536
- 2023.12.22 Expert Report of Gabriel Weintraub_Redacted, GOOG-AT-MDL-C-000035253

C.5. Bates stamped productions, including access to Plaintiffs' entire production database, as well as the following documents and Google and third-party productions made since June 7, 2024

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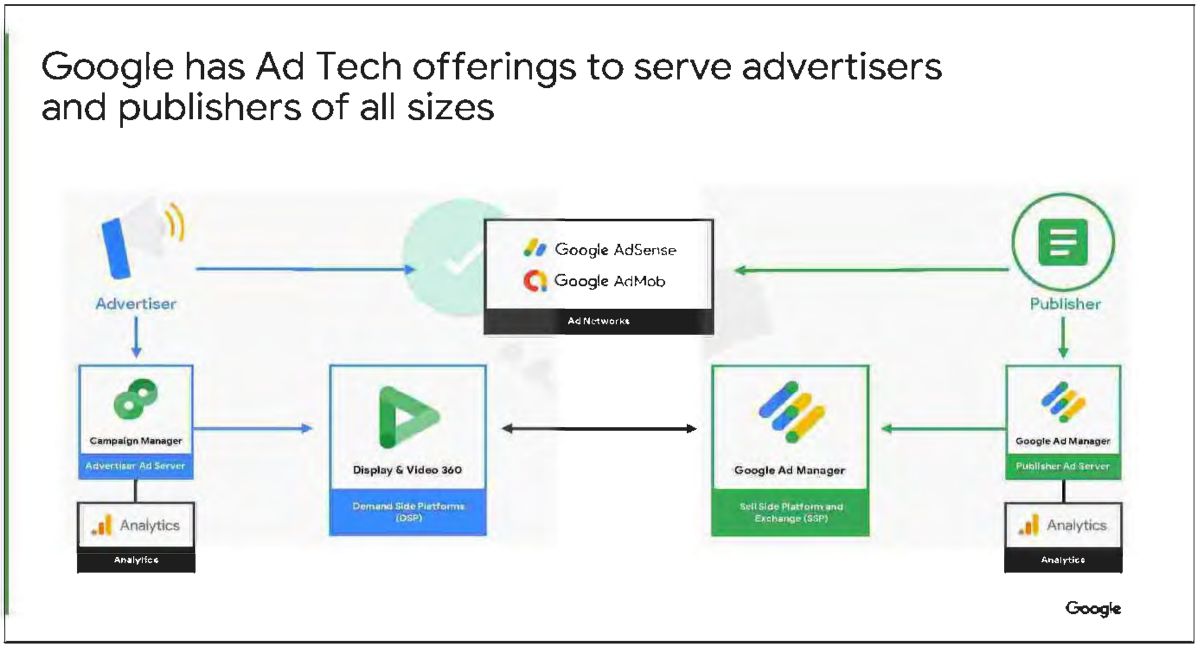
- GOOG-TEX-00513684
- GOOG-TEX-00643890
- GOOG-TEX-00689539
- GOOG-TEX-00705131
- GOOG-TEX-00715805
- GOOG-TEX-00716782
- GOOG-TEX-00777573
- GOOG-TEX-00778301
- GOOG-TEX-00797340
- GOOG-TEX-00806640
- GOOG-TEX-00806682
- GOOG-TEX-00814407
- GOOG-TEX-00825713
- GOOG-TEX-00828547
- GOOG-TEX-00831660
- GOOG-TEX-00850729
- GOOG-TEX-00858576
- GOOG-TEX-00905673
- GOOG-TEX-00959457
- GOOG-TEX-00959461
- GOOG-TEX-00969525
- GOOG-TEX-00978814
- GOOG-TEX-01004466
- GOOG-TEX-01036150
- GOOG-TEX-01142635
- GOOG-TEX-01244428
- GOOG-TEX-01279945

- GOOG-TEX-00974499
- GOOG-TEX-00001418
- GOOG-TEX-00597317
- METATX_000000680
- NEXSTAR090311

Appendix D. Ad Tech industry figures

(171) The figure below, Figure 33, provides another visualization of how the six DVAA products (AdMob, AdSense, AdX, CM360, DFP, and DV360) interact amongst themselves. It also shows how networks, like GDN, and exchanges, like AdX, perform similar functions, connecting advertisers with publishers. The figure, which is from an internal Google presentation in 2020, refers to AdX and DFP as Google Ad Manager.

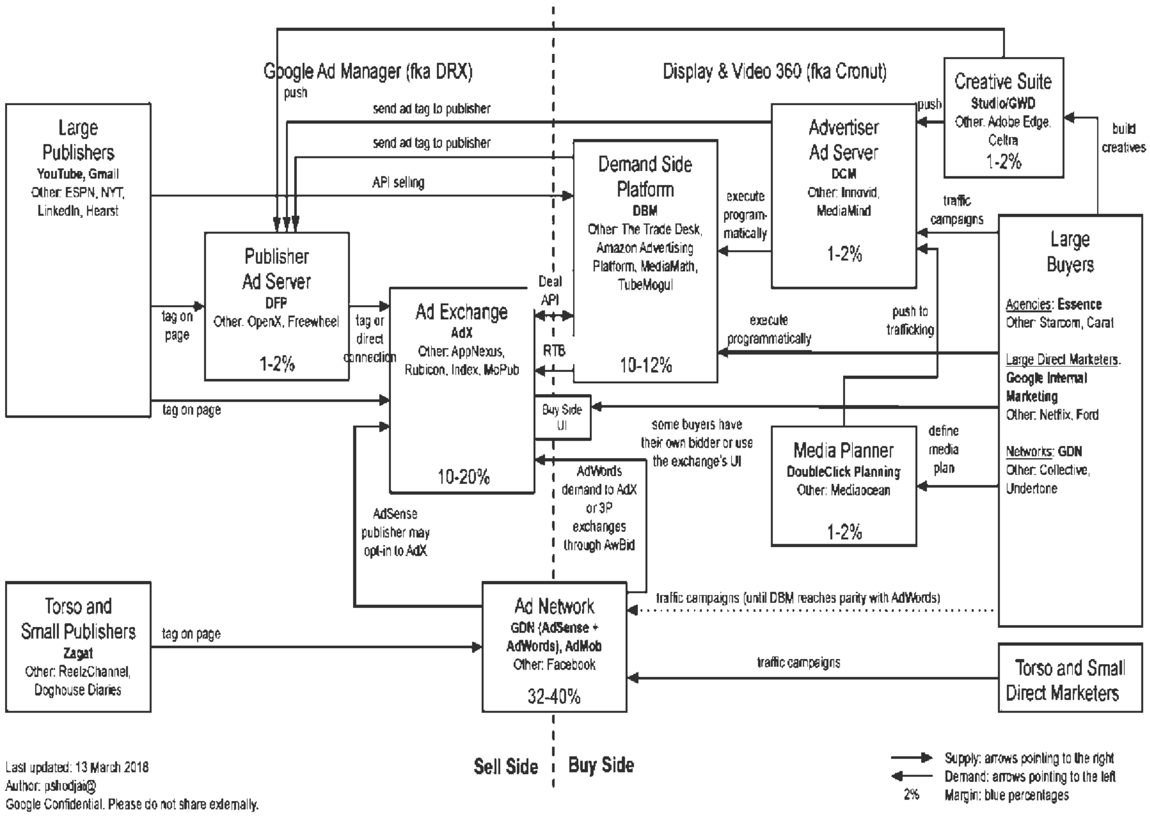
Figure 33: Google Ad Tech products



Source: GOOG-DOJ-AT-01510462.

(172) The figure below, which comes from an internal Google document, broadens the scope of Ad Tech products beyond DVAA to the entire market, including non-Google products and services. Each box in the figure represents an Ad Tech product type or actor in the industry, with Google's products and services listed in bold. This figure, from 2018, uses some outdated names for Google products, which are described in the figure notes.

Figure 34: Google's 2018 visualization o various Ad Tech components



Source: GOOG-NE-04597999.
Notes: The names of several Google products have changed since this figure was made in 2018. For example, Google DBM is now known as DV360, and AdWords is now known as Google Ads.

Appendix E. Alphabet penalty allocation by year

Figure 35: Alpha et Inc. penalties y year (nominal allocation)

Year	Alphabet Inc. Total Revenue	$50 billion (payment plan 2013-2023)	$50 billion (lump sum 2023)
2013	$7,605	$227	
2014	$66,001	$1,966	
2015	$74,989	$2,233	
2016	$90,272	$2,689	
2017	$110,855	$3,302	
2018	$136,819	$4,075	
2019	$161,857	$4,821	
2020	$182,527	$5,436	
2021	$257,637	$7,673	
2022	$282,836	$8,424	
2023	$307,394	$9,155	$50,000
Total	$1,678,792	$50,000	$50,000

Source: CapIQ; Andrien Report, Exhibit 2, Note 8.
Note: Alphabet Inc. revenues in 2013 are multiplied by the portion of the year during which the alleged deceptive trade practices occurred (November 11 – December 31)

EXHIBIT 8

UNITED STATES DISTRICT COURT

EASTERN DISTRICT OF TEXAS

SHERMAN DIVISION

The State of Texas, et. al. Plaintiff, v. Google LLC, Defendant.	Case No: 4:20-CV-957-SDJ

Rebuttal Expert Report of Anil Somayaji, PhD

Signed on September 9, 2024, in Nashville, Tennessee, USA

Anil Somayaji

Anil Somayaji, PhD

Table of Contents

I. INTRODUCTION

A. Assignment

1. I understand that on December 16, 2020, a multistate coalition led by the State of Texas filed a lawsuit against Google LLC ("Google") asserting violations by Google of federal and state antitrust laws and violations of other state laws, in connection with Google's conduct in the online display advertising industry and as to digital advertising technologies ("Ad Tech" or "Ad Tech stack"). Currently, 16 States (Texas, Alaska, Arkansas, Florida, Idaho, Indiana, Kentucky, Louisiana, Mississippi, Missouri, Montana, Nevada, North Dakota, South Carolina, South Dakota, and Utah) and the Territory of Puerto Rico are Plaintiffs in the case (the "Plaintiff States"). I have been retained by counsel for the State of Texas ("Counsel") to provide expert analysis and opinions on behalf of all of the Plaintiff States.

2. I have been asked by Counsel to respond to the opinion in Dr. Milgrom's expert report ("Milgrom Report") that advertisers and publishers are able to optimize their behavior in response to modifications that Google introduces to its auction programs.

3. To this end, I investigated whether there exists an information advantage for Google and users of its auction-based advertising tools over third-party buyers that distribute ads through Google's ad-serving infrastructure. More specifically, I examined the source code of Google's ad infrastructure, Google's internal documentation and correspondence that have been disclosed as part of these proceedings, as well as publicly available primary materials, all of which are listed in Appendices Appendix A: Materials Relied Upon - Appendix C: Source code appendix of this report. I have further considered the opening report and appendices Dr. Hochstetler and the rebuttal report of Dr. Rinard, and I considered the rebuttal report of Dr. Milgrom.

4. The opinions in this report are based on my research and experience in the field of secure, distributed software systems, and the materials briefed to me by Counsel. Additionally, I have also relied on my own experience in complex, distributed computer systems that I have developed through my research in computer security, complex systems, and my teaching of distributed operating systems. My opinion is based on my review of the source code and documents available

to me as of the time this report was published.[1] I further reserve the right to supplement my report should any additional information be produced in this case, as well as to create and use graphics, figures, and/or other illustrations at trial to support my conclusions.

5. I am being compensated for my work in this case at a rate of $600 per hour. My compensation does not depend on or affect the opinions that I offer.

6. I am competent to testify regarding the matters and opinions I present in this report. I further have personal knowledge of the facts and statements presented herein, and if asked could testify that each statement is true and correct.

B. Qualifications

7. I am an Associate Professor in the School of Computer Science at Carleton University, in Ottawa, Canada. I also serve as the Associate Director of the Carleton Internet Security Lab. I received a B.S. in Mathematics from the Massachusetts Institute of Technology in 1994 and a Ph.D. in Computer Science from the University of New Mexico in 2002. While working on my Ph.D., I was a visiting graduate student at the Artificial Intelligence Laboratory at the Massachusetts Institute of Technology between 1996 and 1997 and a Research Assistant at the University of New Mexico between 1995-2002. After graduating, I was a Postdoctoral scholar at the University of New Mexico, following which I worked as a Consultant for Sandia National Laboratories, before joining the faculty at the School of Computer Science at Carleton University. I have been a full-time university professor since 2003.

8. I have authored or co-authored over 50 publications across refereed conferences publications, peer-reviewed journal articles, and other invited publications and articles. My papers have appeared in leading academic journals, such as the Journal of Computer Security, the Journal of the Association for Computing Machinery (ACM), and the IEEE Transactions on Dependable and Secure Computing. Collectively, my papers have been cited over 10,000 times in published work. I have been part of many program committees in the computer security space. I have been most involved in the New Security Paradigms workshop, for which I have served as program committee chair, general chair, program committee member, and web chair over many years.

[1] I understand that Google produced chat log data. I reserve the right to review and analyze such data and to serve a supplemental report in the future.

9. During my tenure at Carleton University, I have taught courses in operating systems, distributed operating systems, computer systems security, biological approaches to computer security, intrusion detection, web applications, mobile development, and computer games.

10. My academic research is focused on the areas of computer security, operating systems, intrusion detection, artificial life, and complex adaptive systems. My approach to research in computer security is fundamentally interdisciplinary, with my original efforts inspired by the human immune system where I have studied how to build a "computer immune system." More recently I have worked in usable security, a research area at the intersection of human-computer interaction (HCI) and computer security, where I have studied security in online dating and how people identify each other when texting. No matter the work, the core of my interests lies in understanding how systems of all kinds defend themselves and how those insights can help us build computers that defend themselves.

11. My background makes me particularly suited to addressing the question of Google's information advantage in ad distribution because:

    a) Through my work with developing defenses for the Linux kernel, mail servers, web servers, and other applications, I have significant experience in examining large codebases. Google's ad infrastructure is a very large codebase.
    b) Through my teaching courses in distributed operating systems over many years, I am familiar with many of the key systems and abstractions Google uses internally, as they have been described in highly cited research papers authored by Google's engineers and researchers.
    c) Through my work in online machine learning systems for detecting anomalous program and user behavior (a central part of my long-standing research program in intrusion detection and response), I have a deep understanding of what it takes to successfully model the behavior of people, computer systems, and their interactions.
    d) As a researcher in computer security and complex adaptive systems, I have extensive knowledge of the dynamics of systems where multiple parties cooperate, compete, and fight against each other over time. The code of Google's ad infrastructure is, in part, a record of how Google's relationship with advertisers, publishers, and other

actors has evolved over decades, and my research background allows me to recognize patterns in this dynamic.

12. My curriculum vitae is attached as Appendix D: Curriculum Vitae of Dr. Anil Somayaji to my report.

II. SUMMARY OF OPINIONS

13. In this rebuttal report, I respond to Dr. Milgrom's claims that publishers and advertisers are able to optimize their behavior in response to the changes that Google introduces to its ad auction programs.[2]

14. My review of Google's source code and documents indicates that Google maintains an information advantage over all other parties participating in the Google ad ecosystem, whether they be advertisers, publishers, or third-party ad exchanges. This information imbalance between Google and non-Google participants impacts which ads are displayed, where they are shown, and the price that is paid for them.

15. This information imbalance can be seen in the information that is shared with advertisers and exchanges as part of each request for an ad—more publisher and user data is communicated to auctions involving Google's first-party tools than to auctions involving third-party tools and direct deals, including [redacted]. [redacted]

16. As part of the process for conducting an auction for an ad slot, Google [redacted]

[2] Milgrom Report, ¶ 25.

[redacted] To better understand Google's information advantage, I examined how the ad exchange and data flow mechanisms interact inside Google's ad infrastructure.

17. [redacted]

18. My report proceeds as follows. First, in Section III, I discuss Dr. Milgrom's expert report, explaining how some of his arguments imply that Google does not have a significant information advantage over other participants. I then examine key portions of the source code of this infrastructure that illustrate 1) the information advantage that Google buying tools have over third-party buyers [redacted] in Section IV, and 2) in Section V, how Google's [redacted]. As such machine learning models are products of vast amounts of proprietary data, they add another layer to Google's information advantage.

III. DR. MILGROM'S CLAIM ABOUT PUBLISHERS' AND ADVERTISERS' ABILITY TO OPTIMIZE THEIR BEHAVIOR FAILS TO CONSIDER GOOGLE'S INFORMATION ADVANTAGE

19. In his report, Dr. Milgrom discusses the purported benefits to publishers and advertisers of the contested Google auction programs,[3] and states that these programs are best understood in a historical context.[4] He also states that Google balances the interests of publishers and advertisers and that competitors have similar auction mechanisms or products.[5] He then focuses on the importance of incentives in the advertising market. Dr. Milgrom argues that advertisers and

[3] *Ibid.*, ¶ 15.
[4] *Ibid.*, ¶ 18-20.
[5] *Ibid.*, ¶ 21-24.

publishers have both the incentive and ability to optimize their behavior to achieve the outcomes they value.[6] Central to this argument is the observation that advertisers and publishers regularly conduct experiments in ad markets, and that Google offers features to facilitate those experiments.[7]

20. I note that Dr. Milgrom does not provide any support to suggest that experiments by advertisers and publishers are capable of revealing internal changes Google may make to its auction mechanisms or products. The ability of experiments to uncover underlying patterns of behavior depends on the complexity of the system being analyzed. The more complex the system is, the harder it is for experiments to give reliable insights. For instance, a lot can be understood about gravity just by observing the path of a thrown ball. Understanding the ability of an individual to jump, however, requires an understanding of biomechanics. And to understand why someone might choose to jump requires a deep understanding of the much more complicated human psychology, with such insights only being valid in the most general sense. It is my opinion that the degree to which experiments could give reliable insights into Google's internal operations would depend on the complexity of Google's systems. As I will explain, Google's ad infrastructure is extremely complex, and the insights that advertisers and publishers can glean are therefore limited.

21. I understand Dr. Milgrom to be opining that advertisers and publishers can "know" what Google does internally well enough to optimize their outcomes, or at least well enough to avoid unfavorable outcomes. I explore this assertion by examining the question of **information imbalance**, which in this report I define to mean that different parties possess different knowledge or amounts of knowledge in the context of any given ad auction. For example, there might be differences in the parties' knowledge of how a seller's impression is put up for auction or how buyers choose bids to submit to the auction. Thus, the information imbalance could affect how the winning bid and advertisement are determined in the auction.

22. Within the context of information imbalance, I refer to parties with relatively more knowledge or more detailed knowledge as having an **information advantage**, and I refer to parties with relatively less knowledge or less detailed knowledge as having an **information disadvantage**.

[6] *Ibid.*, ¶ 25-31.
[7] *Ibid.*, ¶ 32-34.

23. The complexity of Google's ad infrastructure and the nature of the systems it contains thus directly pertain to Google's information advantage in online advertising facilitated through its platforms. To be specific, I can more easily understand the core information being used in Google's ad auctions by examining the code running those auctions. If the information available to different bidders is the same, it would be my opinion that there is no information imbalance within Google's advertisement system. However, if it can be shown that different parties have access to different information, and if that information can impact how auctions are conducted, it would instead be my opinion that there is an information imbalance that favors certain parties over others. Such is the case here. In the rest of this report, I discuss the information imbalances at the level of ad requests and auction bidding.

IV. GOOGLE'S AD BUYING TOOLS HAVE ACCESS TO MORE GRANULAR TARGETING INFORMATION THAN DO THIRD-PARTY BUYERS

24. Dr. Milgrom argues that advertisers and publishers are incentivized and able to optimize their behavior in response to Google's changes to its auction programs through experimentation.[8] He ignores the fact that vastly different amounts of information are shared with Google's ad buying tools compared to third-party buyers. In this section, I examine the difference in request-level information that is passed to third-party buyers versus Google's first-party buying tools to determine the level of information imbalance between the external and internal auctions within Google's ad infrastructure. To this end, I reviewed Google's source code snapshots produced by Google in this matter to understand the information flows within Google's infrastructure.[9] Further detail is available in Appendix C: Source code appendix.

25. My review of Google's source code was an iterative process comprised in part of:

   a. Identifying the relevant code to be reviewed. To do this, I consulted Google's technical documents produced in this matter, which frequently included references to filenames, classes, and/or methods within the source code. These references provided a valuable

[8] *Ibid.*, ¶ 25-34.
[9] While I primarily refer to the 2015 source code snapshot, I also examined other versions of the source code. [redacted]

foundation for my review. I also identified relevant code files by conducting keyword searches within the codebase.

b. Next, I analyzed the key functions of the code [redacted].

c. During this process, I documented all my observations and findings, particularly noting request-level details of the requests made to and from first party and third-party buyers including the data types and fields used to represent them.

d. Throughout the process, I validated all my findings by cross-checking against Google documentation and reexamining the relevant code and function traces. [redacted] (Appendix C: Source code appendix).

26. The ad serving process begins when a user lands on a publisher's website. [redacted].[10]

27. After [redacted]

a) [redacted][11]. [redacted]

[10] Hochstetler Report, ¶ 81, ¶117.
[11] *Ibid.*, ¶ 87.

b) [redacted][12] [redacted][13]

28. I illustrate the above ad request process in Figure 1 below.

Figure 1: [redacted]

[redacted]

29. [redacted]

30. [redacted]

---

[12] [redacted]

[13] For simplicity, I use the term "third-party buyers" synonymously with "RTB buyers" to refer to third-party buying tools and exchanges that distribute ads through Google's ad infrastructure, [redacted].

[redacted][14] [redacted].

31. [redacted][15] [redacted]

A. Information Given to Real Time Bidders

32. [redacted].[16,17,18] [redacted]

Table 1 - [redacted]

[redacted]

[14] Google, "Targeting Types", Google Ad Manager Help, https://support.google.com/admanager/answer/2884033 (accessed September 8, 2024).

[15] BidRequest is Google's code object that is sent to RTB buyers to request a bid for an incoming ad request. Google Developers, "Process the Request", Authorized Buyers, https://developers.google.com/authorized-buyers/rtb/request-guide (accessed September 8, 2024).

[16] While I specifically refer to the 2015 source code snapshot herein, I also examined other versions of the source code. As mentioned in Footnote 9, above, [redacted]

[17] [redacted]

[18] Google, "Real-Time Bidding Protocol Buffer v.69", Real-Time Bidding Protocol, https://web.archive.org/web/20150923115610/https://developers.google.com/ad-exchange/rtb/downloads/realtime-bidding-proto (accessed September 8, 2024).

[redacted]

[19] A [redacted]

[20] [redacted]

[redacted]

[redacted]

33. [redacted][22] [redacted][23] [redacted].[24] [redacted]

[21] [redacted]

[22] Protocol buffer (protobuf) is an open-source, language- and platform-neutral data format developed by Google for serializing structured data. Protobuf, "Protocol Buffers", Protocol Buffers Documentation, https://protobuf.dev/ (accessed September 8, 2024).

[23] [redacted]

[24] [redacted]

[redacted].[25]

B. Selected differences in the information shared with Google's ad buying tools and RTB buyers

a) [redacted]

34. [redacted][26] [redacted]"[27]

35. [redacted].[28]

36. [redacted].[29] [redacted].[30] [redacted]

[25] I have also observed that the latest publicly available `BidRequest` protobuf (Google, "Authorized Buyers Real-time Bidding Protocol Buffer", Authorized Buyers, https://developers.google.com/authorized-buyers/rtb/downloads/realtime-bidding-proto (accessed September 8, 2024)) contains more information than its 2015 counterpart. [redacted]

[26] [redacted]

[27] [redacted]

[28] Google, "Authorized Buyers Real-time Bidding Protocol Buffer", Authorized Buyers, https://developers.google.com/authorized-buyers/rtb/downloads/realtime-bidding-proto (accessed September 8, 2024).

[29] [redacted]

[30] [redacted]

37. [redacted]

Table 2 - [redacted][31]

[redacted]

[31] [redacted]

[32] [redacted]

[redacted]

b) [redacted]

38. [redacted].[33] [redacted]

Table 3 - [redacted]

[redacted]

[33] [redacted]

c) [redacted]

39. [redacted]

Table 4 - [redacted]

[redacted]

40. [redacted]"[35] [redacted].[36] [redacted].[37]

41. [redacted]

---

[34] [redacted]

[35] Hochstetler Report, ¶ 78.

[36] Hochstetler Report, ¶ 78.

[37] [redacted]

a) [redacted][38]

b) [redacted]"[39]

c) [redacted][40]

42. [redacted]

V. GOOGLE [redacted]

43. Dr. Milgrom claims that advertisers and publishers are able to experiment and adjust their auction behavior in order to optimize returns,[41] without addressing the impact of the information imbalance between [redacted], which I analyzed in the previous section. In my review of the produced Google ad infrastructure code, I have further observed [redacted])[42] [redacted]

38 [redacted]
39
40
41 Milgrom Report, ¶ 32-34.
42 Google Ads Help, Google, "Clickthrough rate (CTR): Definition", https://support.google.com/google-ads/answer/2615875?hl=en (accessed September 8, 2024).

[redacted].[43]

Figure 2: [redacted][44]

[redacted]

44. [redacted].[45]

45. [redacted]

[43] As mentioned earlier, I also examined other versions of the source code, [redacted].

[44] [redacted]

[45] [redacted]

[redacted][46] [redacted]. [47] [redacted][48]

46. [redacted]. [49] [redacted], [50] [redacted]. [51]

47. [redacted]

---

[46] [redacted]

[48] [redacted]

[49] [redacted]

[50] [redacted]

[51] [redacted]

VI. APPENDIX A: MATERIALS RELIED UPON

A. Expert Reports

2024.06.07 Expert Report of Jacob Hochstetler

2024.07.30 Expert Report of Paul R. Milgrom

B. Documents from Production

GOOG-AT-MDL-001283820

GOOG-AT-MDL-009414680

GOOG-AT-MDL-015554886

GOOG-AT-MDL-018512842

GOOG-AT-MDL-B-003952932

GOOG-AT-MDL-B-005080323

GOOG-DOJ-AT-02492756

GOOG-AT-MDL-012693796

C. Source Code Files

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

D. Public Sources

Google Ad Manager Help, Google, "Targeting Types", https://support.google.com/admanager/answer/2884033?sjid=5613954590018599404-NC. Accessed on September 8, 2024.

Google Ads Help, Google, "Clickthrough rate (CTR): Definition", https://support.google.com/google-ads/answer/2615875?hl=en. Accessed September 8, 2024.

Google Developers, Authorized Buyers, "Process the Request", https://developers.google.com/authorized-buyers/rtb/request-guide. Accessed September 8, 2024.

Google, "Real-Time Bidding Protocol Buffer v.69", Real-Time Bidding Protocol, https://web.archive.org/web/20150923115610/https://developers.google.com/ad-exchange/rtb/downloads/realtime-bidding-proto. Accessed September 8, 2024.

Google Developers, Google, "Authorized Buyers Real-time Bidding Protocol Buffer", https://developers.google.com/authorized-buyers/rtb/downloads/realtime-bidding-proto. Accessed September 8, 2024.

Google, Google Ads Help, "Cost-per-thousand impressions (CPM): Definition", https://support.google.com/google-ads/answer/6310. Accessed September 8, 2024.

Mozilla, "MIME types (IANA media types)", https://developer.mozilla.org/en-US/docs/Web/HTTP/Basics_of_HTTP/MIME_types. Accessed September 8, 2024.

IAB Tech Lab, "Content Taxonomy", https://iabtechlab.com/standards/content-taxonomy/. Accessed September 8, 2024.

Protobuf, "Protocol Buffers", Protocol Buffers Documentation, https://protobuf.dev/. Accessed September 8, 2024.

VII. APPENDIX B: MATERIALS CONSIDERED

A. Discovery Responses

All available discovery responses produced within the matter of *The State of Texas, et al. v. Google*, Case Number: 4:20-cv-00957-SDJ, including:

1. The Parties' amended initial disclosures;
2. The Parties' discovery responses and objections to Interrogatories, Requests for Admission, and Requests for Production; and
3. Google's written responses to Plaintiffs' Rule 30(b)(6) Notice.

B. Case Filings

The live pleadings (complaint and answer) within the matter of The State of Texas, et al. v. Google, Case Number: 4:20-cv-00957-SDJ, including the Fourth Amended Complaint.

C. Declarations, Depositions and ROG Responses

Deposition Transcripts & Exhibits

All available deposition transcripts and exhibits within the matter of *The State of Texas, et al. v. Google*, Case Number: 4:20-cv-00957-SDJ, including:

1. Deposition and Exhibits of [redacted] April 1, 2024
2. Deposition and Exhibits of [redacted], April 3, 2024
3. Deposition and Exhibits of [redacted], April 12, 2024
4. Deposition and Exhibits of [redacted], April 17, 2024
5. Deposition and Exhibits of [redacted], April 19, 2024
6. Deposition and Exhibits of [redacted], April 23, 2024
7. Deposition and Exhibits of [redacted], April 26, 2024
8. Deposition and Exhibits of [redacted], April 26, 2024
9. Deposition and Exhibits of [redacted], April 29, 2024
10. Deposition and Exhibits of [redacted], April 30, 2024
11. Deposition and Exhibits of [redacted], May 1, 2024
12. Deposition and Exhibits of [redacted] May 1, 2024
13. Deposition and Exhibits of [redacted], May 2, 2024
14. Deposition and Exhibits of [redacted], April 5, 2024
15. Deposition and Exhibits of [redacted], May 2, 2024
16. Deposition and Exhibits of [redacted], May 10, 2024
17. Deposition and Exhibits of [redacted], May 15, 2024
18. Deposition and Exhibits of [redacted] May 17, 2024
19. Deposition and Exhibits of [redacted] Vol 1, April 26, 2024
20. Deposition and Exhibits of [redacted] Vol 2, May 21, 2024
21. Deposition and Exhibits of [redacted], May 21, 2024
22. Deposition and Exhibits of [redacted], May 22, 2024

23. Deposition and Exhibits of [redacted], May 23, 2024
24. Deposition and Exhibits of [redacted], May 24, 2024
25. Deposition and Exhibits of [redacted] Vol 1, April 19, 2024
26. Deposition and Exhibits of [redacted] Vol 2, May 2, 2024
27. Deposition and Exhibits of [redacted] Vol 3, May 3, 2024
28. Deposition and Exhibits of [redacted] Vol 4, May 24, 2024
29. Deposition and Exhibits of [redacted], May 2, 2024
30. Deposition and Exhibits of [redacted], May 23, 2024
31. Deposition and Exhibits of [redacted], May 3, 2024
32. Deposition and Exhibits of [redacted], May 3, 2024
33. Deposition and Exhibits of [redacted], May 23, 2024
34. Deposition and Exhibits of [redacted], April 30, 2024
35. Deposition and Exhibits of [redacted], May 2, 2024
36. Deposition and Exhibits of [redacted], May 1, 2024
37. Deposition and Exhibits of [redacted] May 1, 2024
38. Deposition and Exhibits of [redacted], April 16, 2024
39. Deposition and Exhibits of [redacted], April 23, 2024
40. Deposition and Exhibits of [redacted], April 25, 2024
41. Deposition and Exhibits of [redacted], April 12, 2024
42. Deposition and Exhibits of [redacted] April 19, 2024
43. Deposition and Exhibits of [redacted], April 30, 2024
44. Deposition and Exhibits of [redacted], May 2, 2024
45. Deposition and Exhibits of [redacted], May 3, 2024
46. Deposition and Exhibits of [redacted], May 1, 2024
47. Deposition and Exhibits of [redacted], April 22, 2024
48. Deposition and Exhibits of [redacted], May 1, 2024
49. Deposition and Exhibits of [redacted] May 3, 2024
50. Deposition and Exhibits of [redacted], April 29, 2024
51. Deposition and Exhibits of [redacted], April 25, 2024
52. Deposition and Exhibits of South Carolina ([redacted]), April 23, 2024
53. Deposition and Exhibits of Indiana ([redacted]), April 26, 2024
54. Deposition and Exhibits of Indiana ([redacted]), April 26, 2024
55. Deposition and Exhibits of Nevada ([redacted]), April 29, 2024
56. Deposition and Exhibits of Arkansas ([redacted]), May 1, 2024
57. Deposition and Exhibits of Alaska ([redacted]), May 3, 2024
58. Deposition and Exhibits of Florida ([redacted]), April 22, 2024
59. Deposition and Exhibits of Idaho ([redacted]), May 3, 2024
60. Deposition and Exhibits of Idaho ([redacted]), May 3, 2024
61. Deposition and Exhibits of Kentucky ([redacted]), April 25, 2024
62. Deposition and Exhibits of Louisiana ([redacted]), May 3, 2024
63. Deposition and Exhibits of Mississippi ([redacted]), April 25, 2024
64. Deposition and Exhibits of Mississippi ([redacted]), April 25, 2024
65. Deposition and Exhibits of Missouri ([redacted]), May 10, 2024

66. Deposition and Exhibits of Montana ([redacted]), May 1, 2024
67. Deposition and Exhibits of North Dakota ([redacted]), May 2, 2024
68. Deposition and Exhibits of Puerto Rico ([redacted]), May 1, 2024
69. Deposition and Exhibits of South Dakota ([redacted]), April 29, 2024
70. Deposition and Exhibits of Texas ([redacted]), May 24, 2024
71. Deposition and Exhibits of Texas ([redacted]), April 17, 2024
72. Deposition and Exhibits of Utah ([redacted]), April 30, 2024
73. Deposition and Exhibits of Utah ([redacted]), April 30, 2024
74. Deposition and Exhibits of [redacted]), May 1, 2024
75. Deposition and Exhibits of [redacted] ([redacted]), May 1, 2024
76. Deposition and Exhibits of [redacted] ([redacted]), May 3, 2024
77. Deposition and Exhibits of [redacted] ([redacted]), April 3, 2024
78. Deposition and Exhibits of [redacted]), May 2, 2024
79. Deposition and Exhibits of [redacted] ([redacted] May 1, 2024
80. Deposition and Exhibits of [redacted]), May 3, 2024
81. Deposition and Exhibits of [redacted]), May 3, 2024
82. Deposition and Exhibits of [redacted] ([redacted]), April 29, 2024
83. Deposition and Exhibits of [redacted] ([redacted]), April 29, 2024
84. Deposition and Exhibits of [redacted]), April 19, 2024

All available deposition transcripts and exhibits within the matter of *USA v. Google*, Case Number: 1:23-cv-00108-LMB-JFA, including:

1. Deposition and Exhibits of [redacted], August, 16 2023
2. Deposition and Exhibits of [redacted], September 1, 2023
3. Deposition and Exhibits of [redacted], August 29, 2023
4. Deposition and Exhibits of [redacted], September 6, 2023
5. Deposition and Exhibits of [redacted], September 8, 2023
6. Deposition and Exhibits o[redacted], September 29, 2024
7. Deposition and Exhibits of [redacted], September 5, 2023
8. Deposition and Exhibits of [redacted], September 26, 2023
9. Deposition and Exhibits of [redacted], September 8, 2023
10. Deposition and Exhibits of [redacted], September 26, 2023
11. Deposition and Exhibits of [redacted], August 9, 2023
12. Deposition and Exhibits of [redacted], August 31, 2023
13. Deposition and Exhibits of [redacted], September 22, 2023
14. Deposition and Exhibits of [redacted], September 28, 2023
15. Deposition and Exhibits of [redacted], September 8, 2023

16. Deposition and Exhibits of [redacted], September 21, 2023
17. Deposition and Exhibits of [redacted], August 25, 2023
18. Deposition and Exhibits of [redacted], August 25, 2023
19. Deposition and Exhibits of [redacted], September 22, 2023
20. Deposition and Exhibits of [redacted], September 29, 2023
21. Deposition and Exhibits of [redacted], August 29, 2023
22. Deposition and Exhibits of [redacted], October 26, 2023
23. Deposition and Exhibits of [redacted] July 28, 2023
24. Deposition and Exhibits of [redacted], August 23, 2023
25. Deposition and Exhibits of [redacted], September 28, 2023
26. Deposition and Exhibits of [redacted] (November, 11, 2023)
27. Deposition and Exhibits of [redacted] (August 15, 2023)
28. Deposition and Exhibits of [redacted] (November 14, 2023)
29. Deposition and Exhibits of [redacted] (November 15, 2023)
30. Deposition and Exhibits of [redacted] (November 14, 2023)
31. Deposition and Exhibits of [redacted] (30B6 errata only) (November 14, 2023)
32. Deposition and Exhibits of [redacted] (November 3, 2023)
33. Deposition and Exhibits of [redacted] (August 16, 2023)
34. Deposition and Exhibits of [redacted] (November 7, 2023)
35. Deposition and Exhibits of [redacted] November 9, 2023)
36. Deposition and Exhibits of [redacted] (October 30, 2023)
37. Deposition and Exhibits of [redacted] (August 11, 2023)
38. Deposition and Exhibits of [redacted] (November 2, 2023)
39. Deposition and Exhibits of [redacted] (November 16, 2023)
40. Deposition and Exhibits of [redacted] (August 29, 2023)
41. Deposition and Exhibits of [redacted] (November 14-15, 2023)
42. Deposition and Exhibits of [redacted] (April 1, 2024)
43. Deposition and Exhibits of [redacted] (November 3, 2024)
44. Deposition and Exhibits of [redacted] (November 3, 2024)
45. Deposition and Exhibits of [redacted] (30(b)6) (November 14, 2023)
46. Deposition and Exhibits of [redacted] (August 16, 2023)
47. Deposition and Exhibits of [redacted] (November 7, 2023)
48. Deposition and Exhibits of [redacted] (November 9, 2023)
49. Deposition and Exhibits of [redacted] (April 3, 2024)
50. Deposition and Exhibits of [redacted] (October 10, 2023 and November 8, 2023)
51. Deposition and Exhibits of [redacted] (April 17, 2024)
52. Deposition and Exhibits of [redacted] (April 29, 2024)
53. Deposition and Exhibits of [redacted] (Noveber 11, 2023)
54. Deposition and Exhibits of [redacted] (October 10, 2023)

All available deposition transcripts and exhibits within the matter of *In re: Google Digital Advertising Antitrust Litigation*, Case Number: 1:21-md-03010-PKC, including the depositions and exhibits of:

1.	[redacted]	6/19/2024
2.	[redacted]	6/20/2024
3.	[redacted] [redacted]	6/21/2024
4.	[redacted] ([redacted]	5/21/2024
5.	[redacted] ([redacted]	6/25/2024
6.	[redacted]	6/25/2024
7.	[redacted] ([redacted])	6/27/2024
8.	[redacted] (Google)	7/23/2024
9.	[redacted] (Google)	7/23/2024
10.	[redacted]	6/18/2024
11.	[redacted]	5/7/2024
12.	[redacted] (Advertiser)	7/9/2024
13.	[redacted]	7/10/2024
14.	[redacted]	4/25/2024
15.	[redacted]	7/10/2024
16.	[redacted]	6/24/2024
17.	[redacted]	7/12/2024
18.	[redacted]	6/12/2024
19.	[redacted]e	6/13/2024
20.	[redacted]	5/2/2024
21.	[redacted] [redacted])	6/28/2024
22.	[redacted]	6/6/2024
23.	[redacted] (Google)	6/28/2024
24.	[redacted] [redacted])	7/3/2024
25.	[redacted]	6/4/2024
26.	[redacted] [redacted]	7/28/2024
27.	[redacted] [redacted]	7/10/2024
28.	[redacted]	6/25/2024
29.	[redacted]	6/26/2024
30.	[redacted]	6/10/2024
31.	[redacted]	6/27/2024
32.	[redacted]	6/13/2024
33.	[redacted]	6/7/2024
34.	[redacted]	6/25/2024
35.	[redacted]	6/28/2024
36.	[redacted] [redacted]	5/24/2024
37.	[redacted]	6/24/2024
38.	[redacted]	6/27/2024
39.	[redacted] [redacted]	6/11/2024
40.	[redacted] [redacted]	6/12/2024

Other available deposition transcripts and exhibits, including the depositions and exhibits of:

1.	[redacted]	10/2/2020

2.	[redacted]	10/16/2020
3.	[redacted]	7/28/2020
4.	[redacted]	7/21/2020
5.	[redacted]	10/26/2020
6.	[redacted]	11/6/2020
7.	[redacted]	7/31/2020
8.	[redacted]	9/25/2020
9.	[redacted]	10/20/2020
10.	[redacted]	7/17/2020
11.	[redacted]	11/9/2020
12.	[redacted]	11/19/2020
13.	[redacted]	7/24/2020
14.	[redacted]	7/14/2020
15.	[redacted]	11/10/2020
16.	[redacted]	11/2/2020
17.	[redacted]	9/28/2020
18.	[redacted]	2/3/2022
19.	[redacted]	8/11/2021
20.	[redacted]	2/28/2022
21.	[redacted]	10/19/2021
22.	[redacted]	12/9/2021
23.	[redacted]	9/17/2021
24.	[redacted]	11/20/2020
25.	[redacted]	3/30/2021
26.	[redacted]	10/28/2021
27.	[redacted]	8/10/2021
28.	[redacted]	3/31/2021
29.	[redacted]	4/2/2021
30.	[redacted]	4/22/2021
31.	[redacted]	10/28/2021
32.	[redacted]	7/22/2021
33.	[redacted]	10/6/2021
34.	[redacted]	7/20/2021
35.	[redacted]	8/12/2021
36.	[redacted]	9/28/2021
37.	[redacted]	5/17/2021
38.	[redacted]	9/7/2021

D. Expert Reports

Expert Reports & Declarations

All available expert reports, including appendices, backup materials, and cited materials, within the matter of *The State of Texas, et al. v. Google*, Case Number: 4:20-cv-00957-SDJ, including:

1. 2024.06.07 Expert Report of Jeffrey S. Andrien
2. 2024.06.07 Expert Report of Joshua Gans, as well as 2024.07.24 Errata and Supplemental Appendix D
3. 2024.06.07 Expert Report of Jacob Hochstetler
4. 2024.06.07 Expert Report of John Chandler
5. 2024.06.07 Expert Report of Matthew Weinberg
6. 2024.06.07 Expert Report of Parag Pathak
7. 2024.07.30 Expert Report of Anindya Ghose
8. 2024.07.30 Expert Report of Donna L. Hoffman
9. 2024.07.30 Expert Report of Douglas Skinner
10. 2024.07.30 Expert Report of Itamar Simonson
11. 2024.07.30 Expert Report of Martin C. Rinard
12. 2024.07.30 Expert Report of Paul R. Milgrom
13. 2024.07.30 Expert Report of Steven N. Wiggins
14. 2024.08.06 Expert Report of Michael R. Baye
15. 2024.08.06 Expert Report of Jason Nieh

All available expert reports (with redactions) within the matter of *USA v. Google*, Case Number: 1:23-cv-00108-LMB-JFA, including:

1. Declarations of Google Employees
2. 2023.12.22 Expert Report of Gabriel Weintraub, GOOG-AT-MDL-C-000018734
3. 2023.12.22 Expert Report of R. Ravi, GOOG-AT-MDL-C-000019017
4. 2023.12.22 Expert Report of Robin S. Lee, GOOG-AT-MDL-C-000019273
5. 2023.12.22 Expert Report of Rosa Abrantes-Metz, GOOG-AT-MDL-C-000019786
6. 2023.12.22 Expert Report of Thomas S. Respess, GOOG-AT-MDL-C-000020106
7. 2023.12.22 Expert Report of Timothy Simcoe, GOOG-AT-MDL-C-000020274
8. 2024.01.13 Errata to Abrantes-Metz Expert Report, GOOG-AT-MDL-C-000020435
9. 2024.01.13 Errata to Ravi Expert Report, GOOG-AT-MDL-C-000020437
10. 2024.01.13 Errata to Respess Expert Report, GOOG-AT-MDL-C-000020440
11. 2024.01.13 Errata to Simcoe Expert Report, GOOG-AT-MDL-C-000020467
12. 2024.01.13 Errata to Weintraub Expert Report, GOOG-AT-MDL-C-000020471
13. 2024.01.23 Chevalier Expert Report, GOOG-AT-MDL-C-000020474
14. 2024.01.23 Ferrante Expert Report, GOOG-AT-MDL-C-000020714
15. 2024.01.23 Ghose Expert Report, GOOG-AT-MDL-C-000020767
16. 2024.01.23 Israel Expert Report, GOOG-AT-MDL-C-000021036
17. 2024.01.23 Milgrom Expert Report, GOOG-AT-MDL-C-000021794
18. 2024.01.23 Rinard Expert Report, GOOG-AT-MDL-C-000022191
19. 2024.01.23 Shirky Expert Report, GOOG-AT-MDL-C-000022229
20. 2024.01.23 Simonson Expert Report, GOOG-AT-MDL-C-000022290
21. 2024.01.23 Skinner Expert Report, GOOG-AT-MDL-C-000022948

22. 2024.02.13 Expert Rebuttal Report of Adoria Lim, GOOG-AT-MDL-C-000023002
23. 2024.02.13 Expert Rebuttal Report of Gabriel Weintraub, GOOG-AT-MDL-C-000023226
24. 2024.02.13 Expert Rebuttal Report of Kenneth Wilbur, GOOG-AT-MDL-C-000023322
25. 2024.02.13 Expert Rebuttal Report of R. Ravi, GOOG-AT-MDL-C-000023435
26. 2024.02.13 Expert Rebuttal Report of Robin S. Lee, GOOG-AT-MDL-C-000023516
27. 2024.02.13 Expert Rebuttal Report of Rosa Abrantes-Metz, GOOG-AT-MDL-C-000023887
28. 2024.02.13 Expert Rebuttal Report of Timothy Simcoe, GOOG-AT-MDL-C-000024064
29. 2024.02.13 Expert Rebuttal Report of Wayne Hoyer, GOOG-AT-MDL-C-000024138
30. 2024.02.13 Expert Rebuttal Report of Wenke Lee, GOOG-AT-MDL-C-000024270
31. 2024.02.16 Errata to Ravi Rebuttal Report, GOOG-AT-MDL-C-000024387
32. 2024.02.20 Errata to Simcoe Rebuttal Report, GOOG-AT-MDL-C-000024389
33. 2024.02.23 Errata to Weintraub Rebuttal Report, GOOG-AT-MDL-C-000024390
34. 2024.02.23 Supplemental Errata to Weintraub Expert Report, GOOG-AT-MDL-C-000024391
35. 2024.02.24 Errata to Wilbur Rebuttal Report, GOOG-AT-MDL-C-000024392
36. 2024.02.26 Errata to Hoyer Rebuttal Report, GOOG-AT-MDL-C-000024397
37. 2024.02.28 Errata to Abrantes-Metz Rebuttal Report, GOOG-AT-MDL-C-000024399
38. 2024.03.04 Expert Supplemental Report of Robin S. Lee, GOOG-AT-MDL-C-000024403
39. 2024.03.08 Consolidated Errata to Lee Rebuttal Report, GOOG-AT-MDL-C-000024436
40. 2024.01.13 Expert Report of Weintraub Errata, GOOG-AT-MDL-C-000040965
41. 2024.01.13 Expert Report of Simcoe Errata, GOOG-AT-MDL-C-000040961
42. 2024.01.13 Expert Report of Respess Errata_with Figure Errata_Redacted, GOOG-AT-MDL-C-000040934
43. 2024.01.13 Expert Report of R Ravi Errata, GOOG-AT-MDL-C-000040931
44. 2024.01.13 Expert Report of Abrantes-Metz Errata, GOOG-AT-MDL-C-000040929
45. 2024.03.08 Consolidated Errata to Lee Rebuttal Report, GOOG-AT-MDL-C-000040926
46. 2024.03.04 Expert Supplemental Report of Robin S. Lee, PhD, GOOG-AT-MDL-C-000040893
47. 2024.02.28 Rebuttal Report Errata of Rosa Abrantes-Metz Signed, GOOG-AT-MDL-C-000040889
48. 2024.02.25 Expert Rebuttal Report of Hoyer Errata, GOOG-AT-MDL-C-000040887
49. 2024.02.24 Wilbur Rebuttal Errata, GOOG-AT-MDL-C-000040882
50. 2024.02.23 Weintraub Rebuttal Report Errata, GOOG-AT-MDL-C-000040881
51. 2024.02.23 Expert Report of Weintraub Supplemental Errata, GOOG-AT-MDL-C-000040880
52. 2024.02.20 Errata to Simcoe Rebuttal Report, GOOG-AT-MDL-C-000040879
53. 2024.02.16 Errata to Ravi Rebuttal Report (Highly Confidential), GOOG-AT-MDL-C-000040877
54. 2024.02.13 Rebuttal Report of Rosa Abrantes-Metz, GOOG-AT-MDL-C-000040700
55. 2024.02.13 Expert Report of Wenke Lee, GOOG-AT-MDL-C-000040583
56. 2024.02.13 Expert Rebuttal Report of Wayne Hoyer, GOOG-AT-MDL-C-000040451

57. 2024.02.13 Expert Rebuttal Report of Timothy Simcoe_Redacted, GOOG-AT-MDL-C-000040377
58. 2024.02.13 Expert Rebuttal Report of Robin S. Lee_Redacted, GOOG-AT-MDL-C-000040006
59. 2024.02.13 Expert Rebuttal Report of R Ravi, GOOG-AT-MDL-C-000039925
60. 2024.02.13 Expert Rebuttal Report of Kenneth Wilbur_Redacted, GOOG-AT-MDL-C-000039812
61. 2024.02.13 Expert Rebuttal Report of Gabriel Weintraub_Redacted, GOOG-AT-MDL-C-000039716
62. 2024.02.13 Expert Rebuttal Report of Adoria Lim_Redacted, GOOG-AT-MDL-C-000039492
63. 2024.01.23 Expert Report of William Clay Shirky, GOOG-AT-MDL-C-000039431
64. 2024.01.23 Expert Report of Paul R. Milgrom, GOOG-AT-MDL-C-000039034
65. 2024.01.23 Expert Report of Martin C. Rinard, GOOG-AT-MDL-C-000038996
66. 2024.01.23 Expert Report of Mark A. Israel_Redacted, GOOG-AT-MDL-C-000038238
67. 2024.01.23 Expert Report of Judith A. Chevalier_Redacted, GOOG-AT-MDL-C-000037998
68. 2024.01.23 Expert Report of Itamar Simonson, GOOG-AT-MDL-C-000037340
69. 2024.01.23 Expert Report of Douglas Skinner, GOOG-AT-MDL-C-000037286
70. 2024.01.23 Expert Report of Anthony J. Ferrante, GOOG-AT-MDL-C-000037233
71. 2024.01.23 Expert Report of Anindya Ghose_Redacted, GOOG-AT-MDL-C-000036954
72. 2023.12.22 Expert Report of Timothy Simcoe_Redacted, GOOG-AT-MDL-C-000036793
73. 2023.12.22 Expert Report of Thomas Respess_Redacted, GOOG-AT-MDL-C-000036625
74. 2023.12.22 Expert Report of Rosa Abrantes-Metz_Redacted, GOOG-AT-MDL-C-000036305
75. 2023.12.22 Expert Report of Robin S. Lee, PhD_Redacted, GOOG-AT-MDL-C-000035792
76. 2023.12.22 Expert Report of R Ravi_Redacted, GOOG-AT-MDL-C-000035536
77. 2023.12.22 Expert Report of Gabriel Weintraub_Redacted, GOOG-AT-MDL-C-000035253

E. Documents from Production

Bates Stamped Productions, including access to Plaintiffs' entire production database, as well as the following documents and Google and third-party productions made since June 7, 2024:

1. [redacted]
2. [redacted]
3. [redacted]
4. [redacted]
5. [redacted]
6. [redacted]
7. [redacted]
8. [redacted]
9. [redacted]
10. [redacted]
11. [redacted]
12. [redacted]
13. [redacted]
14. [redacted]
15. [redacted]
16. [redacted]
17. [redacted]
18. [redacted]
19. [redacted]
20. [redacted]
21. [redacted]
22. [redacted]
23. [redacted]
24. [redacted]

25. [redacted]
26. [redacted]
27. [redacted]
28. [redacted]
29. [redacted]
30. [redacted]
31. [redacted]
32. [redacted]
33. [redacted]
34. [redacted]
35. [redacted]
36. [redacted]
37. [redacted]
38. [redacted]
39. FTC_US-GOOGLE-000004531
40. GOOG-AT-MDL-001004706
41. GOOG-AT-MDL-001094427
42. GOOG-AT-MDL-001168337
43. GOOG-AT-MDL-001263607
44. GOOG-AT-MDL-001283243
45. GOOG-AT-MDL-001283820
46. GOOG-AT-MDL-001314551
47. GOOG-AT-MDL-001390730
48. GOOG-AT-MDL-001391213
49. GOOG-AT-MDL-001399014
50. GOOG-AT-MDL-001835980
51. GOOG-AT-MDL-001857130
52. GOOG-AT-MDL-001880786
53. GOOG-AT-MDL-001933227
54. GOOG-AT-MDL-001937115
55. GOOG-AT-MDL-002105969
56. GOOG-AT-MDL-002105984
57. GOOG-AT-MDL-002124829
58. GOOG-AT-MDL-002266216
59. GOOG-AT-MDL-002390899
60. GOOG-AT-MDL-002393442
61. GOOG-AT-MDL-002614717
62. GOOG-AT-MDL-003161451
63. GOOG-AT-MDL-003262351
64. GOOG-AT-MDL-003262351
65. GOOG-AT-MDL-003267744
66. GOOG-AT-MDL-003436238
67. GOOG-AT-MDL-003446710
68. GOOG-AT-MDL-003528514
69. GOOG-AT-MDL-003902433
70. GOOG-AT-MDL-003972392
71. GOOG-AT-MDL-004025996
72. GOOG-AT-MDL-004074544
73. GOOG-AT-MDL-004232880
74. GOOG-AT-MDL-004233138
75. GOOG-AT-MDL-004288612
76. GOOG-AT-MDL-004300268
77. GOOG-AT-MDL-004416785
78. GOOG-AT-MDL-004436768
79. GOOG-AT-MDL-004438075
80. GOOG-AT-MDL-004492242
81. GOOG-AT-MDL-004555181
82. GOOG-AT-MDL-006099844
83. GOOG-AT-MDL-006161050
84. GOOG-AT-MDL-006212867
85. GOOG-AT-MDL-006217592
86. GOOG-AT-MDL-006235606
87. GOOG-AT-MDL-006334729
88. GOOG-AT-MDL-006467434
89. GOOG-AT-MDL-006873424
90. GOOG-AT-MDL-006940085
91. GOOG-AT-MDL-006941741
92. GOOG-AT-MDL-006966530
93. GOOG-AT-MDL-007175167
94. GOOG-AT-MDL-007238430
95. GOOG-AT-MDL-007343585
96. GOOG-AT-MDL-007346556
97. GOOG-AT-MDL-007351425
98. GOOG-AT-MDL-007364833
99. GOOG-AT-MDL-007375672
100. GOOG-AT-MDL-007387750
101. GOOG-AT-MDL-007397182
102. GOOG-AT-MDL-007397197
103. GOOG-AT-MDL-007907825
104. GOOG-AT-MDL-008148533 / GOOG-AT-MDL-008148529

105. GOOG-AT-MDL-008390176
106. GOOG-AT-MDL-008506490
107. GOOG-AT-MDL-008517788
108. GOOG-AT-MDL-008560277
109. GOOG-AT-MDL-008588684
110. GOOG-AT-MDL-008682082 / GOOG-AT-MDL-008682071
111. GOOG-AT-MDL-008754374
112. GOOG-AT-MDL-008781681
113. GOOG-AT-MDL-008819670
114. GOOG-AT-MDL-008835346
115. GOOG-AT-MDL-008858602
116. GOOG-AT-MDL-008881206
117. GOOG-AT-MDL-008886980
118. GOOG-AT-MDL-008953893
119. GOOG-AT-MDL-008964888
120. GOOG-AT-MDL-008979664
121. GOOG-AT-MDL-008991390
122. GOOG-AT-MDL-009026140
123. GOOG-AT-MDL-009289718
124. GOOG-AT-MDL-009291120
125. GOOG-AT-MDL-009299907
126. GOOG-AT-MDL-009321580
127. GOOG-AT-MDL-009414680
128. GOOG-AT-MDL-009429957
129. GOOG-AT-MDL-012332781
130. GOOG-AT-MDL-012512067
131. GOOG-AT-MDL-012514705
132. GOOG-AT-MDL-012524006
133. GOOG-AT-MDL-012549335
134. GOOG-AT-MDL-012551468
135. GOOG-AT-MDL-012567469
136. GOOG-AT-MDL-012693796
137. GOOG-AT-MDL-012693796
138. GOOG-AT-MDL-012694825
139. GOOG-AT-MDL-012767138
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F. Public Sources

Google Ad Manager Help, Google, "Targeting Types", https://support.google.com/admanager/answer/2884033?sjid=5613954590018599404-NC. Accessed on September 8, 2024.

Google Ads Help, Google, "Clickthrough rate (CTR): Definition", https://support.google.com/google-ads/answer/2615875?hl=en. Accessed September 8, 2024.

Google Developers, Authorized Buyers, "Process the Request", https://developers.google.com/authorized-buyers/rtb/request-guide. Accessed September 8, 2024.

Google, "Real-Time Bidding Protocol Buffer v.69", Real-Time Bidding Protocol, https://web.archive.org/web/20150923115610/https://developers.google.com/ad-exchange/rtb/downloads/realtime-bidding-proto. Accessed September 8, 2024.

Google Developers, Google, "Authorized Buyers Real-time Bidding Protocol Buffer", https://developers.google.com/authorized-buyers/rtb/downloads/realtime-bidding-proto. Accessed September 8, 2024.

Google, Google Ads Help, "Cost-per-thousand impressions (CPM): Definition", https://support.google.com/google-ads/answer/6310. Accessed September 8, 2024.

Google Ads Help, Google, "About Enhanced CPC (ECPC)", https://support.google.com/google-ads/answer/2464964?hl=en. Accessed September 9, 2024.

Google Ads Help, Google, "Determine a bid strategy based on your goals", https://support.google.com/google-ads/answer/2472725. Accessed September 9, 2024.

Google, "How Open Bidding Works", https://support.google.com/admanager/answer/7128958?sjid=1860511006731764262-EU#zippy=%2Cwhat-information-is-sent-to-buyers-with-each-open-bidding-request. Accessed September 9, 2024.

Google, "Value CPM," https://support.google.com/admanager/answer/177222?hl=en. Accessed September 9, 2024.

Mozilla, "MIME types (IANA media types)", https://developer.mozilla.org/en-US/docs/Web/HTTP/Basics_of_HTTP/MIME_types. Accessed September 8, 2024.

IAB Tech Lab, "Content Taxonomy", https://iabtechlab.com/standards/content-taxonomy/. Accessed September 8, 2024.

Protobuf, "Protocol Buffers", Protocol Buffers Documentation, https://protobuf.dev/. Accessed September 8, 2024.

VIII. APPENDIX C: SOURCE CODE APPENDIX

A. [redacted]

1. [redacted][52] [redacted].[53] [redacted].

2. [redacted].[54]

3. [redacted]

[52] While I refer to the 2015 code snapshot, I also reviewed the additional snapshots produced by Google. [redacted]

[53] [redacted]

[54] Google, "Authorized Buyers Real-time Bidding Protocol Buffer", Google Developers, https://developers.google.com/authorized-buyers/rtb/downloads/realtime-bidding-proto (accessed September 8, 2024).

[redacted]

55 [redacted]

56 [redacted]

[redacted]

[redacted]

[redacted]

58 [redacted]

59 [redacted]

60 [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

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61 [redacted]

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62 [redacted]

63 [redacted]

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65 [redacted]

66 [redacted]

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67 [redacted]

68 [redacted]

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69 [redacted]

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70 [redacted]

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[redacted]

[redacted]

[redacted]

[redacted]

B. [redacted]

4. [redacted]

5. [redacted].[71] [redacted]

6. [redacted][72] [redacted][73] [redacted][74] [redacted]

7. [redacted][75] [redacted]

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[71] [redacted]

[72] [redacted]

[73] [redacted]

[74] [redacted]

a) [redacted][76] [redacted][77] [redacted]

d) [redacted][78] [redacted][79] [redacted]

8. [redacted][80] [redacted].

9. Figure 3 below illustrates [redacted]

Figure 3: [redacted]

[redacted]

10. [redacted]

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[76] [redacted]

[77] [redacted]

[78] [redacted]

[79] [redacted]

[80] [redacted]

1) [redacted]

11. [redacted]

12. [redacted] [redacted]

a) [redacted]

2) [redacted]

13. [redacted]

14. [redacted] [redacted][6] [redacted]

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81 [redacted]

82 [redacted]

83 [redacted]

84 [redacted]

85 [redacted]

86 [redacted]

[redacted]

a) [redacted][87] [redacted]

b) [redacted].[88]

c) [redacted].[89] [redacted][90] [redacted]

d) [redacted][91] [redacted]

e) [redacted].[92]

f) [redacted].[93]

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87 [redacted]

88 [redacted]

89 [redacted]

90 [redacted]

91 [redacted]

92 [redacted]

93 [redacted]

15. [redacted] [redacted][94] [redacted][95] [redacted][96] [redacted]

[94] [redacted]

[95] [redacted]

[96] [redacted]

IX. APPENDIX D: CURRICULUM VITAE OF DR. ANIL SOMAYAJI

[DOCUMENT STARTS ON THE FOLLOWING PAGE]

Anil Somayaji

[redacted]

http://people.scs.carleton.ca/~soma

August 23, 2024

EDUCATION

Ph.D., Computer Science, University of New Mexico, Albuquerque, NM, July 2002. "Operating System Stability and Security through Process Homeostasis."

1999 Complex Systems Summer School (Santa Fe Institute), Santa Fe, NM, June 1999.

Visiting Graduate Student, Artificial Intelligence Laboratory, Massachusetts Institute of Technology, Cambridge, MA, September 1996–June 1997.

B.S., Mathematics, Massachusetts Institute of Technology, Cambridge, MA, 1994.

RECENT EMPLOYMENT

Fall 2003–Present. School of Computer Science, Carleton University, Ottawa, Ontario, Canada. 2003–2008, Assistant Professor; 2008–Present, Associate Professor.

March 2022–May 2024. Consultant for Allens, Australia. (Expert Witness.)

May 2012-Present. Advisor for Zighra, Inc, Ottawa, Ontario, Canada.

November 2016–July 2018. Securelytix, Inc, Wellesley, MA. Chief Scientist. (Early-stage startup, pre-funding/revenue.)

2003–2016. Consultant for Skillbridge Training LLC, Waltham, MA.

Spring 2003. Consultant for Sandia National Laboratories, Albuquerque, NM.

1994–2002. Department of Computer Science, University of New Mexico, Albuquerque, NM. Postdoc, Fall 2002. Research Assistant, 1995–Spring 2002; Teaching Assistant, 1994–1995.

RESEARCH INTERESTS

Computer security, operating systems, systems administration, biologically-inspired computing, complex adaptive systems.

PUBLICATIONS (2014-2024)

Refereed Journal Publications

F.L. Lévesque, S. Chiasson, A. Somayaji, J.M. Fernandez. "Technological and Human Factors of Malware Attacks: A Computer Security Clinical Trial Approach." *ACM Transactions on Privacy and Security (TOPS)*, Vol. 21, Issue 4, Article No. 18 (2018).

S. Sharma, A. Somayaji, N. Japkowicz. "Learning over subconcepts: Strategies for 1-class classification." *Computational Intelligence*, Vol. 34, Issue 2, pp. 440–467 (2018).

Refereed Conference Publications

N. Mansourzadeh, A. Somayaji, J. Jaskolka, "A Fragility Metric for Software Diversity." 19th Annual Symposium on Information Assurance (ASIA'24), Albany, NY (2024).

W. Findlay, A. Somayaji, D. Barrera, "bpfbox: Simple Precise Process Confinement with eBPF." *2020 ACM SIGSAC Conference on Cloud Computing Security Workshop (CCSW)*, Virtual Conference (2020).

N. Dabbour, A. Somayaji, "Towards In-Band Non-Cryptographic Authentication." *2020 New Security Paradigms Workshop (NSPW)*, Virtual Conference (2020).

M. Burgess, A. Somayaji. "After the BlockCloud Apocalypse." *2018 New Security Paradigms Workshop (NSPW)*, Windsor, UK (2018).

B. Obada-Obieh, A. Somayaji, "Can I believe you?: Establishing Trust in Computer Mediated Introductions." *2017 New Security Paradigms Workshop (NSPW)*, Santa Cruz, CA USA (2017).

B. Obada-Obieh, S. Chiasson, and A. Somayaji, ""Don't Break My Heart!": User Security Strategies for Online Dating." *Workshop on Usable Security (USEC)*, San Diego, CA USA (2017).

F.L. Lévesque, J.M. Fernandez, A. Somayaji, and D. Batchelder, "National-level risk assessment: A multi-country study of malware infections." *15th Annual Workshop on the Economics of Information Security (WEIS)*, Berkeley, CA USA (2016).

F.L. Lévesque, A. Somayaji, d. Batchelder, J.M. Fernandez, "Measuring the health of antivirus ecosystems." *10th International Conference on Malicious and Unwanted Software (MALWARE)*, Puerto Rico, USA (2015).

F.L. Lévesque, J.M. Fernandez, A. Somayaji, "Risk Prediction of Malware Victimization Based on User Behavior." *9th International Conference on Malicious and Unwanted Software: The Americas (MALWARE)*, Puerto Rico, USA (2014).

T. Moni, S. Salahudeen, A. Somayaji, "The Malware Author Testing Challenge." *Second Workshop on Anti-malware Testing Research (WATeR)*, Canterbury, UK (2014).

M. Bingham, A. Skillen, and A. Somayaji, "Even Hackers Deserve Usability: An Expert Evaluation of Penetration Testing Tools." *9th Annual Symposium on Information Assurance (ASIA'14)*, Albany, NY (2014).

J. Aycock, A. Somayaji, and J. Sullins, "The Ethics of Coexistence: Can I Learn to Stop Worrying and Love the Logic Bomb?" *2014 IEEE International Symposium on Ethics in Engineering, Science, and Technology*, Chicago, IL (2014).

Invited Publications

B. Persaud, B. Obada-Obieh, N. Mansourzadeh, A. Moni, and A. Somayaji. "FrankenSSL: Recombining Cryptographic Libraries for Software Diversity." *11th Annual Symposium on Information Assurance (ASIA'16)*, Albany, NY (2016).

Patents

DC Dutt, AB Somayaji, MJK Bingham. "System and method for behavioural biometric authentication using program modelling." US Patent 10,554,676 (2020).

DC Dutt, AB Somayaji, MJK Bingham. "System and method for implicit authentication." US Patent 10,588,017 (2017, 2019, 2020).

DC Dutt, AB Somayaji. "Context-dependent authentication system, method and device." US Patent 10,740,758 (2017, 2020).

CE Gates, TG Brown, A Somayaji, and Y Li. "System and method for dynamic access control based on individual and community usage patterns." US Patent 9,356,939 (2016).

Technical Reports

W. Findlay, D. Barrera, and A. Somayaji. "Bpfcontain: Fixing the soft underbelly of container security." arXiv preprint arXiv:2102.06972 (2021).

RESEARCH GRANTS

Year	Agency	Type	Amount per year
2014-19	NSERC	Discovery	$32,000
2013-2015	NSERC/ISTP	CRD (Zighra)	$112,500 (avg.)
2013	NSERC	Engage (Zighra)	$24,967
2009-14	NSERC	Discovery	$19,000
2008-13	NSERC	ISSNet	$63,160 (avg.)
2011	MITACS, CA	Internship Cluster	$80,000
2009	CSE	Research Grant	$23,810
2008	Swisscom	Research Grant	$15,000
2007-9	MITACS	Comm., Net., & Security	$33,750 (joint w/ Paul van Oorschot)
2007-9	NSERC	Discovery	$19,700

2006-9	RIM	Research Grant	$50,000 (joint w/ Paul van Oorschot)
2006	CSE	Research Grant	$23,128 (joint w/ Paul van Oorschot)
2005-7	MITACS	Comm., Net., & Security	$33,750 (joint w/ Paul van Oorschot)
2004	Alcatel	Research Grant	$50,000 (joint w/ Paul van Oorschot)
2004-7	NSERC	Discovery	$19,700
2003	Carleton	Start-up	$20,000

PROFESSIONAL SERVICE

New Security Paradigms Workshop (NSPW): Program Committee member (1998, 1999, 2007, 2019), Web Presence Chair (2010–2023), Senior Program Chair (2009, 2018), Junior Program Chair (2008, 2017), General Chair (2015), Vice General Chair (2014).

ACM Cloud Computing Security Workshop (CCSW): Program Committee member, 2020, 2021, 2022.

Recent Advances in Intrusion Detection (RAID): Program Committee member, 2009–2014.

Privacy, Security and Trust (PST): Program Committee member, 2008, 2012, 2013.

Applied Cryptography and Network Security (ACNS): Program Committee member, 2013.

ACM Conference on Computer and Communications Security (CCS): Program Committee member, 2008, 2010, 2011, 2012.

Annual Computer Security Apps Conference (ACSAC): Program Committee member, 2010, 2011, 2012.

2012 Financial Cryptography and Data Security (FC): Program Committee member.

2010 Workshop on Cyber Security Experimentation and Test (CSET): Program Committee member.

2009 IEEE Conference on Malicious and Unwanted Software (MALWARE): Program Committee member.

USENIX Security Symposium: Program Committee member, 2006, 2008.

2008 International Conference on Information Systems Security (ICISS): Program Committee member.

2008 ICCCN Network Security Track: Program Committee member.

2008 IEEE Conference on Malicious and Unwanted Software (MALWARE): Program Committee member.

2007 Workshop on Rapid Malcode (WORM): Program Committee member.

2007 International Conference on Distributed Computing Systems (ICDCS): Program Committee member.

2006 Workshop on Interdisciplinary Systems Approach in Performance Evaluation and Design of Computer and Communication Systems (Inter-Perf): Program Committee member.

ACADEMIC RESPONSIBILITIES

Courses

COMP 2601, Mobile Applications: Winter 2023.

COMP 4000/5102, Distributed Operating Systems: Winter 2008, Fall 2008, Winter 2011, Winter 2014, Winter 2015, Fall 2017, Fall 2018, Fall 2019, Fall 2021, Winter 2023. Revived course.

COMP 3000, Operating Systems: Fall 2004, Fall 2005, Winter 2006, Winter 2007, Fall 2007, Fall 2010, Fall 2011, Fall 2012, Fall 2014, Fall 2015, Fall 2017, Fall 2018, Winter 2019, Fall 2019, Winter 2020, Fall 2021, Fall 2022. Revised course curriculum, added mandatory lab tutorials.

COMP 1601, Mobile App Development: Winter 2021, Winter 2022.

COMP 4501, Advanced Facilities for Real-Time Games: Winter 2021.

Adaptive Security: Fall 2020. New course.

COMP 4108, Computer Systems Security: Winter 2016, Winter 2018.

COMP 2406, Fundamentals of Web Apps: Winter 2013, Fall 2013, Winter 2014, Winter 2015, Winter 2016. New course.

Operating Systems and Web Security: Fall 2012. New course.

COMP 1501, Introduction to Computer Game Design: Fall 2007, Fall 2008 (co-taught with Prof. Michel Barbeau), Winter 2012. New course, first course in new Computer Game Design stream.

Intrusion Detection: Winter 2006, Winter 2007, Winter 2011. New course.

Biological Approaches to Computer Security: Winter 2004, Winter 2005, Winter 2012. New course.

COMP 4109, Applied Cryptography: Winter 2004, Winter 2005.

Completed Graduate Supervision

Emma Sewell, MCS (co-advised with Lianying Zhao), August 2023. “Hy2: A Hybrid Vulnerability Analysis Method."

John Shortt, MCS (co-advised with Amy Felty), January 2023. “A System for Bounding the Execution Cost of WebAssembly Functions.”

William Findlay, MCS, August 2021. “A Practical, Lightweight, and Flexible Confinement Framework in eBPF.”

Anis Ghazvinian, MASc (HCI), January 2020. “Understanding User Trust Processes in Internet Apps.”

Vidhi Kirit Shah, MCS, January 2020. "User Acceptance of Online Tracking If 'Forgetting' Was An Option."

Mohamed Alsharnouby, MCS, September 2019. "Thread homeostasis Real-Time Anomalous Behavior Detection Using Short Sequences of Messages for Safety-Critical Software."

Nour Dabbour, MASc (HCI), May 2019. "Do I know you? Evaluating Human-to-Human Authentication via Conversational Interfaces."

Borke Obada-Obieh, MCS, September 2017. "The Issue of Trust in Computer Mediated Introductions (CMI)."

Michael Bingham, MCS, May 2016. "Towards Effective Behavioural Biometrics for Mobile Devices."

Shiven Sharma, Ph.D. (co-advised with Nathalie Japkowicz), May 2016. "Learning the Sub-Conceptual Layer: A Framework for One-Class Classification."

Abdulrahman Hijazi, Ph.D., January 2014. "Network Traffic Characterization Using (p,n)-grams Packet Representation."

Saran Neti Maruti Ramanarayana, MCS, September 2012. "Towards a Theory of Software Diversity for Security."

Terri Oda, Ph.D., October 2011. "Simple Security Policy for the Web."

Alex Cowperthwaite, MCS, September 2011. "Trust Models for Remote Hosts."

Gunes Kayacik, Postdoc, Sept. 2009–August 2011.

Blair Foster, MCS, June 2011. "Object File Program Recombination of Existing Software Programs Using Genetic Algorithms."

Carson Brown, MCS (co-advised with Paul van Oorschot), February 2011. "A Meta-Scheme for Authentication Using Text Adventures."

Preeti Raman, MCS, September 2008. "JaSPIn: JavaScript based Anomaly Detection of Cross-site Scripting Attacks."

Evan Hughes, MCS, September 2006. "Parsing Streaming Network Protocols."

Yiru Li, MCS, November 2005. "Email Archive Intrusion Detection."

Current Graduate Students

Heather Farrar, MCS student, since September 2019.

William Findlay, Ph.D. student (co-supervised with David Barrera), since September 2021.

Nilofar Mansourzadeh, Ph.D. student, since January 2016.

Emma Sewell, MCS student (co-supervised with Lianying Zhao), since September 2021.

John Shortt, MCS student (co-supervised with Amy Felty), since March 2021.

Evelyn Yang, MCS student, since September 2021.

ADMINISTRATIVE RESPONSIBILITIES

Sabbatical, 2009–2010, 2016–2017, 2023-2024.

SCS Representative, SCAP (Science Curriculum Advisory Committee), 2017–2023.

Chair, SCS Faculty Search Committee (Security), 2018–2019.

Chair, SCS Faculty Search Committee (Systems), 2017–2018.

Member, SCS Faculty Search Committee, 2004–2005, 2005–2006, 2006–2007, 2007–2008, 2010–2011, 2015–2016.

Member, SCS Curriculum Committee, 2014–2015.

Chair, SCS Curriculum Reinvention Committee, 2009–2014.

Chair, SCS Curriculum Committee, 2010–2011.

SCS Honours Project Coordinator, 2005–2007.

Secretary, SCS Tenure and Promotion Committee, 2005–2006.

Member, SCS Tenure and Promotion Committee, 2004–2005, 2011–2012.

Member, SCS Director Search Committee, 2005–2006 and 2007–2008.

School of Computer Science CUASA representative, 2005–2006.

EXPERT TESTIMONY

Epic Games, Inc. & Anor v. Google LLC & Ors (NSD190/2021) (Reports, Deposition, Trial testimony)

Epic Games, Inc. & Anor v. Apple Inc. & Anor (NSD1236/2020) (Reports, Deposition, Trial testimony)

EXHIBIT 9

UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF TEXAS

STATE OF TEXAS et al., Plaintiffs vs. GOOGLE LLC, Defendant	Case Number 4:20-cv-00957

EXPERT REBUTTAL REPORT OF JEFFREY S. ANDRIEN

SEPTEMBER 9, 2024

HIGHLY CONFIDENTIAL

TABLE OF CONTENTS

I. INTRODUCTION

1. I, Jeffrey Andrien, previously filed an expert report in this matter on June 7, 2024 ("Opening Report"). My qualifications, experience, and compensation are described in the Opening Report and my CV is an appendix to that report. I attach an updated CV to this report as **Appendix 1**.

2. Since the time of my Opening Report, I have reviewed the Expert Report of Professor Steven N. Wiggins ("Wiggins Report") and the Expert Report of Douglas Skinner ("Skinner Report"), each filed on July 30, 2024. I have also reviewed various other response and rebuttal expert reports filed on behalf of the parties in this matter. As indicated herein, some of my opinions in this report rely in part on my review of the expert reports of Dr. Gans, Dr. Weinberg and Dr. DeRamus. I have also been provided access to the document database as well as all depositions related to this litigation. The materials I have relied upon in forming my opinions are listed in my updated list of materials relied upon, attached to this report as **Appendix 2**.

3. I have been asked by the Lanier Law Firm PC, counsel for certain states on behalf of all states that are plaintiffs in this matter (collectively, the "Plaintiff States")[1] to evaluate and respond to the opinions contained in the Wiggins Report and the Skinner Report.

4. Throughout this report, I respond to criticisms and comments that Professor Wiggins and Professor Skinner make regarding the analyses and opinions I proffered in my Opening Report. To the extent that there are opinions of Professor Wiggins or Professor Skinner that may not be addressed in this report, that does not mean that I agree with such opinions.

[1] Unless otherwise specified, capitalized terms are defined in the same manner as in my Opening Report. For example, the Plaintiff States includes the Commonwealths of Kentucky and Puerto Rico. *See* Andrien Opening Report, footnote 1.

5. In addition, it is my understanding that document productions remain ongoing, and that Google and third-parties may produce additional documents in this matter. I further understand that in a parallel case pending in the Eastern District of Virginia, witnesses for Google, the United States Department of Justice, and other plaintiffs will offer expert and fact witnesses to testify in that trial. Accordingly, I reserve the right to review and rely on any additional documents and testimony in conducting my analyses and forming my opinions and conclusions in this case. I reserve the right to supplement or amend this report should my opinions change or need supplementation as a result of my ongoing review of documents and/or testimony.

II. SUMMARY OF OPINIONS

6. After reviewing the Wiggins Report and the Skinner Report, my expert opinions as presented in my Opening Report remain unchanged. To the extent that certain comments or criticisms cause me to alter any of my analyses, I note those in this report; however, any such alterations do not change my overarching conclusions as expressed in my Opening Report, including but not limited to my conclusions regarding the total penalty amounts necessary to have a deterrent effect on Google in the event it is found liable for the alleged misconduct.

7. With regards to the Wiggins Report, I hold the following opinions:

a. The Wiggins Report misrepresents the reliable, generally accepted methodology I used and ignores the factors I considered in determining the ranges of statutory penalties proposed in my Opening Report. This misunderstanding alone undermines and invalidates his critiques. Additionally, the conclusions and criticisms of the reliable, generally accepted methodology I employed are based on Professor Wiggins' own flawed methodology that is inconsistent with the record produced in this case, including Google's own documents and testimony, as well as economic literature.

i. As explained below, I used a reliable, generally accepted methodology in my analyses and calculations of statutory penalties in my Opening Report. I have taught these techniques at both the graduate and undergraduate levels and used such analyses to develop my opinions in numerous cases throughout my career. None of the opinions I have expressed based on these methodologies have ever been excluded by the courts.

ii. I employed a methodology that used a non-linear and holistic approach to assessing penalties.

iii. Given the non-linear and holistic nature of the approach I use to determine penalties, even if the finder of fact determines that violation counts should be reduced as proposed in the Wiggins Report (reductions which, in my opinion are incorrect, [redacted]), the appropriate total penalty amounts for Google's deceptive misconducts should be no less than the lower bounds expressed herein and in my Opening Report, and, as I wrote in my Opening Report, at the determination of the finder of fact, could be ***even higher*** than the upper bounds presented in my Opening Report.

b. The penalties analysis in the Wiggins Report is contradicted by the economic literature on deterrence and does not appropriately assess the amount necessary to deter improper conduct.

i. The Wiggins Report's assertion that the amount of the penalty should be limited to Google's incremental benefits from the alleged misconduct is contradicted by the economic literature on deterrence. This literature establishes that because the probability of detection is less than 100 percent, to establish deterrence, the penalty,

at minimum, must be higher than the greater of the external harm or benefit to the offender. Additionally, the economic literature allows for the wealth of the offender to be considered in setting a penalty. In fact, scholars have also argued that, under certain circumstances, the optimal penalty to establish deterrence is maximal, i.e. as much as the offender can pay.

ii. The Wiggins Report does not contain any analysis to show that the penalties he proposes are sufficient to deter not just Google, but also other potential offenders, from engaging in similar misconduct.

iii. The factors I considered and analyses I performed in my Opening Report are consistent with the economic literature, as well as statutory requirements and case law precedent.

c. The Wiggins Report contains a substantially understated assessment of Google's benefits from the alleged misconduct.

i. Google's testimony and documents indicate that the quantification of Google's benefits from each auction mechanism cannot be performed based on currently available information. Nevertheless, Professor Wiggins attempts to perform such an analysis. However, Professor Wiggins quantification of Google's direct incremental benefits conflicts with and understates the benefits from Bernanke and RPO indicated in Google's contemporaneous estimates.

ii. The Wiggins Report disregards the significant indirect benefits derived by Google from violating DTPA statutes, including those recognized in Google's own documents.

iii. Contrary to Professor Wiggins' assertions, Google's revenue is a relevant measure to consider in determining appropriate civil penalties.

d. The Wiggins Report's claims that Google's history of prior violations discussed in my Opening Report should be ignored because it involves fines and settlements for misconduct that is not similar to the misconduct at issue here is incorrect. Professor Wiggins' classification of certain fines and settlements as privacy related is misleading. Contrary to Professor Wiggins' assertions, the settlements he classifies as privacy-related include settlements for alleged deceptive conduct that violates deceptive trade practices statutes of various jurisdictions. Additionally, the claims that certain fines and settlements should be disregarded because they occurred in foreign jurisdictions, or did not violate deceptive trade practices acts, is unsupported and illogical.

i. The examples of Google's history of prior violations discussed in my Opening Report establish that Google: (i) has history of engaging in deceptive and anticompetitive conduct; and (ii) the previous fines and settlements have been insufficient to deter it from engaging in such conduct.

e. The Wiggins Report's violation counts improperly exclude auctions that should be included.

i. All auctions during the relevant period were tainted by Google's alleged misconduct. During this period Google falsely, misleadingly, and deceptively misrepresented the entire AdX auction model as a second price auction when it was not and stated that all participants were on equal footing in AdX auctions when in fact they were not. The opinions of Dr. Weinberg support this conclusion. The Wiggins Report improperly excludes transactions after insufficient and incomplete

"disclosures" and improperly excludes transactions that he claims "cannot be affected" by Google's misconduct, despite evidence to the contrary.

ii. The Wiggins Report fails to consider the geographic location of publishers and advertisers, and as a result excludes transactions where these entities are based in the United States. The Wiggins Report makes the same oversight when estimating the share of transactions associated with Plaintiff States.

iii. The Wiggins Report improperly excludes in-app transactions despite evidence in the record that demonstrates in-app transactions were subject to Google's deceptive misconduct.

iv. The Wiggins Report inappropriately excludes transactions that are still subject to the Court's decision for certain Plaintiff States.

8. With regards to the Skinner Report, I hold the following opinions:

a. The Skinner Report includes critiques about my display advertising revenue and profit analyses that are either invalid or irrelevant.

i. The Skinner Report claims that certain indirect costs are not reflected in the DVAA P&Ls I relied upon, however he disregards the fact that this information either does not exist or was not produced in discovery despite being requested by the Plaintiff States. Professor Skinner also fails to identify a single category of indirect costs he claims are not reflected in the DVAA P&Ls. He fails to perform any analysis of the economic drivers of the indirect costs he claims are reflected in the DVAA P&Ls. The Skinner Report further disregards the fact that the penalty amount can and should exceed Google's incremental profits when deterrence is considered.

ii. With regard to display revenue, the Skinner Report's critiques are invalid as it, like the Wiggins Report, incorrectly argues that revenue and profits related to AdMob, AdSense for Content, and Campaign Manager should not be included in my analysis. As I explain in my reports, there is ample evidence to suggest these should all be included in my analysis.

b. The Skinner Report incorrectly minimizes Google's overall financial performance and its ability to pay penalties.

i. The Skinner Report suggests that, for purposes of determining an appropriate civil penalty, the overall performance of Alphabet and Google is overinclusive. However, Professor Skinner disregards that the products "at issue" in this matter are part of interconnected misconducts that provide both direct and indirect benefits to Google, and thus its parent Alphabet. In order to deter future violations, a penalty must thus eliminate Google's financial incentive to engage in the alleged misconduct, necessitating consideration of Google and Alphabet's overall financial performance.

ii. Google's performance over the 2013-2023 period has been extraordinary in any sense of the term and is thus highly relevant to my opinions. Assessing the overall wealth of the alleged offender is also supported by the literature on deterrence. Professor Skinner argues that my analysis is solely based on Google's performance when analyzed using "financial measures," but he disregards that using public data and ratios to evaluate performance is a common and accepted practice in the context of litigation. Furthermore, Google's performance has been extraordinary over the relevant time period measured against its peers.

iii. With regard to market indices to which I compare Google's performance, I find that the indices provide a clear and solid benchmark. While the Skinner Report questions the relevance of this comparison, the indices I consider are commonly used to benchmark and assess the performance of firms. Furthermore, Google itself compares its stock market performance to these same indices in its annual reports.

9. The range of penalties presented in my Opening Report is conservative given the considerations outlined in this report and in my Opening Report. The trier of fact may also consider additional factors beyond those I have analyzed that may increase (or decrease) penalties from my range.

III. RESPONSES TO WIGGINS REPORT

A. The Wiggins Report Misrepresents the Framework I Used to Calculate Statutory Penalties

10. Professor Wiggins asserts that the "framework" I used in my Opening Report is limited to an "approach that penalizes Google for at least the benefits it gained associated with the alleged misconduct."[2] This is an incorrect and incomplete description of my analysis.[3] Professor Wiggins selectively quotes excerpts from my Opening Report while ignoring immediately adjacent content that explicitly contradicts his characterization. To illustrate how the Wiggins Report mischaracterizes the framework I used, below I reproduce one relevant section of my Opening Report with the partial sentences as cited in the Wiggins Report underlined, and the complete text the Wiggins Report omitted emphasized in bold.

> From a financial and economic perspective, to deter future violations, the total penalty must eliminate Google's financial incentive to engage in the alleged misconduct. If it remains beneficial for Google to engage in the misconduct after paying a

[2] Wiggins Report, ¶103.

[3] *See* Andrien Opening Report ¶¶106-107 (emphasis added).

> penalty, Google will retain a financial incentive to continue engaging in the misconduct and simply view the penalty as a cost of doing business. **One way to frame the appropriate amount to deter future bad behavior is to consider** an approach that penalizes Google for at least the benefits it gained associated with the alleged misconduct. **However, there are three issues to note with this approach.**
>
> *First*, while the Plaintiff States' deceptive trade practices statutes have caps on the amount of the penalty per violation, **these statutes do not limit the penalty amount to the financial benefits from the misconduct. Therefore, the penalty amount per violation can exceed the amount of financial benefit generated by the misconduct**, as long as the penalty amount is within the penalty cap specified in each Plaintiff State's deceptive trade practices statute.
>
> *Second*, if the defendant may continue to enjoy future benefits from the alleged misconduct, the historical benefits may not capture the total benefit from the misconduct. **Limiting the penalty only to historical benefit in such cases would fail to deter future violations because the misconduct would still be beneficial**.
>
> *Third*, **even a penalty equal to the entire amount of financial benefit from the alleged misconduct may be insufficient to completely eliminate a defendant's financial incentive to engage in future misconduct. This is because if the penalty amount is limited to only the amount of the historical financial benefits associated with the misconduct, the expected value of engaging in future misconduct may still be positive if a defendant perceives that there is a less than 100 percent probability that it will be caught and found liable for future misconduct and/or perceives some other ancillary, indirect, or intangible benefit by engaging in the misconduct.**[4]

a. The Methodology Used in My Opening Report is Reliable and Generally Accepted

11. I used a reliable, generally accepted methodology to calculate statutory penalties in my Opening Report. As stated in my Opening Report, my analysis of the statutory penalties that

[4] Andrien Opening Report, ¶¶106-107.

should be assessed against Google is primarily based on an analysis of three factors: (1) the amount necessary to deter future misconduct; (2) the history of past violations; and (3) the ability of the offending party to pay a penalty.[5] For some Plaintiff States, these factors are defined in their statutes (e.g. Texas, Utah). For others, I am advised by counsel that these factors are recognized in case law (e.g. South Carolina). As set forth in my Opening Report, the penalty range I propose is based on a holistic approach that considers all three economic factors that I evaluate using reasonable, reliable, and generally accepted economic principles and methodologies, which I discuss in more detail below.[6] Therefore, even when the text of a particular Plaintiff State statute does not expressly list factors, it is my opinion that these three factors are still appropriate to consider. Furthermore, I explicitly listed several additional relevant factors that a trier of fact may consider in assessing penalty amounts different from what I proposed—including the bad faith of the defendant, the duration and extent of the defendant's unlawful conduct, active concealment of information by the defendant, the defendant's awareness of the unfair, deceptive, or illegal nature of their conduct, and any other matters that justice may require.[7]

12. Professor Wiggins' contention that my proposed per penalty amounts lack an economic basis is incorrect.[8] In my Opening Report, I set forth the economic bases for my proposed per-penalty amounts, which are based on a variety of economic literature and theories related, in part, to deterrence.[9] As I explained in my Opening Report, one guiding principal underlying my framework regarding proposed per-penalty amounts is the deterrence factor considered in assessing the total amount of civil penalties, as well as the related factors addressing the economic

[5] Andrien Opening Report, ¶7.
[6] Andrien Opening Report, ¶11.h.
[7] *See, e.g.,*Andrien Opening Report, ¶¶7, 11(g)-(h), 58, 64-65, 69-70, 72-75, 103.
[8] Wiggins Report, ¶167.
[9] Andrien Opening Report, § IV.F.

impact on Google and Google's history of previous violations. With these factors in mind, I first calculated the maximum total penalty to Google using the maximum per-violation penalty in each Plaintiff State and the maximum violation count related to Google's misconduct.[10] This results in a penalty of [redacted] Given the vast number of violations, I determined that a per-penalty amount below the maximum per-penalty amounts for each Plaintiff State would still result in a significant total penalty. And thus, next, I determined a range of total penalties that "could have a sufficiently meaningful impact on Google's financial position to act as a deterrence of future violations,"[12] considering the available information on the direct, indirect, historical, and future benefits to Google from its misconduct, Google's financial position, and Google's history of previous violations, fines, and settlements that were insufficient to deter Google from future misconduct. From there, I determined a range of proposed per-violation penalty amounts for Google's misconducts based on the violation counts I assumed.[13] I support these analyses and conclusions with other reliable and commonly used financial analyses, such as financial statement analyses, profit analyses, growth analyses, and revenue analyses.[14]

13. Specifically, in my Opening Report, I first analyzed Google's historical financial performance from information I gleaned from S&P Capital IQ (a company that is world-renowned for providing financial information and analytics to investment firms, banks, corporations, and academic institutions)[15] and various financial statements that Google filed with the Securities and Exchange Commission and/or produced in connection with this litigation. Not only were these

[10] Andrien Opening Report, ¶¶103-105.
[redacted].
[12] Andrien Opening Report, ¶129.
[13] Andrien Opening Report, § IV.H.
[14] Andrien Opening Report, § IV.F, § IV.G, § IV.I.
[15] S&P Capital IQ Pro | S&P Global Market Intelligence (spglobal.com).

data supporting my analyses and opinions reliable, but so too are the types of analyses I performed, such as CAGR calculations, profits calculations, and market capitalization calculations, which are routinely performed in and outside of the litigation context. They are concepts I teach to both graduate and undergraduate students at the McCombs School of Business at the University of Texas at Austin, and ones that I have employed and have been accepted in various litigations, including in cases that have gone to trial. I performed these calculations in my Opening Report in this case, when appropriate, to understand Google's overall corporate performance, its performance in the Plaintiff States, and in the Google business segment at issue in this case.

14. In addition to the financial data described above, I also analyzed the documents produced in this case, deposition testimony, and other materials in an effort to understand the benefits that Google derived from the misconducts at issue in this case. Due to the unavailability of and the limitations of the data produced by Google in this matter, I determined that incremental profit analyses were not possible for several reasons, as I documented throughout my Opening Report, as well as in this Rebuttal Report. For example, when the Plaintiff States requested documents from Google about the revenue and profits attributable to the misconducts at issue in this case, [redacted], a software engineer at Google, submitted a declaration on May 24, 2024 in support of Google's objections and responses to the Plaintiff States' requests in which he stated that: [redacted]

[redacted]"[16] To perform an incremental analysis, one would have to be able to identify and isolate the impacts of the misconducts in all of the other areas of Google's business, because it is clear that they created network effects and synergies across Google's operations, and have positioned Google to realize significant future benefits. I have addressed these issues in both my Opening Report[17] and this report (see Section III.C.b).

15. Finally, to determine the financial impact that a penalty levied on Google at the higher end of my proposed range would have on Google's operations, I employed a series of financial and ratio analyses that are standard in the field of financial economics and which, again, I routinely teach to business students at the McCombs School of Business at the University of Texas at Austin. These analyses include calculating the impact that the penalty would have on Google's assets, its liquidity ratios, and its cash flow. In fact, these concepts are so standard that they are found in many Corporate Finance textbooks and are ones I typically teach to undergraduates in my second lecture as part of a core Finance class that every McCombs undergraduate must take before graduating.[18] I have also used these types of financial ratios in other litigations.

16. While the ultimate penalty against Google will be assessed by the triers-of-fact and may include considerations beyond the scope of the work I have been asked to perform on this matter and may indeed exceed my calculated penalty range, I used a conservative analysis that represents a baseline for appropriate penalties. I reiterate that my conclusions are based on

[16] *See* Declaration of [redacted] in Support of Defendant Google LLC's Responses to Plaintiffs' Third Set of Interrogatories, May 24, 2024 ("[redacted] Declaration"), ¶¶6, 7, 9. *See also* Defendant Google LLC's First Amended Responses and Objections to Plaintiffs' Third Set of Interrogatories, Responses to Interrogatories 7, 8 and 10.
[17] Andrien Opening Report, ¶¶116-123.
[18] *See, e.g.,* Ross, Westerfield, and Jordan, Fundamentals of Corporate Finance, Thirteenth Edition, Chapter 3; Berk and Demarzo, Corporate Finance, Fifth Edition, Chapters 2 and 3.

fundamentally sound methodologies and peer-reviewed principles that are routinely taught and used in the field of financial economics, as well as in corporate litigation. Furthermore, the conclusions I have reached using these methodologies and principles will be useful and informative to the triers-of-fact, who would not be expected to have the financial and economic expertise necessary to conduct them, as they require specialized training, skill, and experience.

b. The Wiggins Report's Misstatements and Misrepresentations of the Methodology Used in the Andrien Report

17. The penalties I have advanced in my Opening Report are conservative and economically justified, as (subject to the trier of fact's adjustment as discussed above) they are sufficient to deter Google from future misconduct, and they are a mere fraction of the maximum statutory penalties set by the various state legislatures. The Wiggins Report's efforts to pare down my proposed penalties to reflect Google's self-serving and artificial limitations on the scope of its own misconduct betrays established economic principles, misrepresents my already conservative framework, and flouts the deterrence goals of the public enforcement regimes.

18. The Wiggins Report did not faithfully describe the methodology I used, criticizing the framework in my Opening Report as "multiplying two inputs"[19]—a violation count and a penalty amount per violation—thus mischaracterizing the framework as constant and linear when it is not, and ignoring the crux of my opinions on, and the importance of, deterrence in assessing adequate civil penalties. Instead, I employed a methodology using a non-linear approach to assessing penalties, as shown in **Figure 1** below.

[19] Wiggins Report, ¶106.

[redacted]

Source: DeRamus Report, Figure 2. Addition of green bar is my own.

19. Figure 1 depicts, in the abstract, a function where the violation amount starts at the statutory limit and remains flat as the violation count goes up, but then decreases and asymptotes with the x-axis as the number of violations continues to increase toward infinity. [redacted]. On the flattened part of this curve, these movements are neither constant nor a one-for-one movement (i.e., every additional violation does not require a constant decrease in the penalty amount and vice versa). The Wiggins Report, however, does assume a one to one reduction where the penalty reduces in direct proportion to the number of violations, (i.e., half the violations begets half the penalty), which is incorrect, given the area of the curve

associated with Google's violation counts. **Figure 2**, below, puts this concept into the context of overall penalty amounts.

[redacted]

Source: DeRamus Report, Figure 1. Addition of red dot is my own.

20. [redacted]

[redacted]

[redacted] Thus, under this model, which follows the generally accepted economic theory on deterrence I discuss more fully below, the amount per violation will not necessarily linearly change should the number of violations change.

21. Additionally, the Wiggins Report does not articulate any opposing methodology, nor does it explain why the generally accepted methodology I employed in my Opening Report is not reliable or acceptable; indeed, the Wiggins Report adopts the calculated amounts for reductions without any adjustment, even though the Wiggins Report acknowledges that the statutory range is far in excess (up to $10,000 per violation for some states and even greater in others)[21] of the [redacted] range I opined was appropriate for misconduct [redacted]. Nor does the Wiggins Report contain any meaningful methodology, discussion, or explanation of the relevant factors to consider in determining statutory civil penalties, and he wholly ignores the importance of deterrence in assessing such penalties. In fact, it does not appear that Professor Wiggins made any attempt to understand the relevant factors to consider – his list of materials considered does not mention any of the relevant statutes or applicable cases, and he also does not mention any instructions or explanations provided to him by counsel.

22. The Wiggins Report appears to ignore that my opinions are focused on the *total penalty amounts* necessary to deter future misconduct,[22] and should the trier of fact determine that the *total violation count* is less than I assume, I have seen no basis—including the flawed analysis

[21] *See, e.g.,* Andrien Opening Report, Table 3.
[22] *See, e.g.,* Andrien Opening Report, ¶7 (emphasis added); *see also*, ¶11(f) ("To deter Google from continuing its misconduct, the *penalty* must eliminate Google's financial incentive to engage in the misconduct.")

in the Wiggins Report—that the total violation count would go so low as to support a substantive change in the *total penalty amounts* calculated in my initial report, which again, are necessarily tied to deterrence.[23] [redacted]"[24] I concluded that total penalties for Bernanke violations alone between $7.27 billion and $21.81 billion are appropriate based on the factors I analyzed. Further, I determined that "Google can pay a penalty at least as high as $29.08 billion without impacting its day-to-day operations or bankrupting the company."[25],[26] Again, these numbers are only based on the factors I reviewed, and the trier of fact may increase (or decrease) them based on their analysis of other factors. Indeed, a reasonable juror may decide that the appropriate penalty is up to and may even exceed the higher bounds for total penalties as presented in my Opening Report.

23. The non-linear nature of the per-penalty amount / total penalty amount curve is also precisely why I discussed the necessary adjustability of the framework I used in my Opening Report, where I highlighted that "[m]y analysis allows for flexibility to allow the trier of fact to

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[23] [redacted]

[24] *See* Andrien Opening Report, ¶127, footnote 315.

[25] Andrien Opening Report, ¶11.

[26] I note further that the trier of fact may believe, due to the magnitude of the number of violations, that an appropriate penalty *should* impact Google's day to day operations in order to have a deterrent effect.

determine penalties,"[27] and that the data on which my analysis relies allows me to adjust violation counts, and why throughout my Opening Report, I reserved my right if necessary to adjust my calculations were the violation counts to change (either upwards or downwards).[28] Instead, it appears that Professor Wiggins attempts to redefine and limit the methodology I used by inappropriately imposing requirements for quantification of monetary *damages* (rather than civil penalties), and to limit the amount of penalties to the estimated past incremental profit Google gained from the alleged misconduct.[29] But this is incorrect. The Plaintiff States are seeking statutory civil penalties for DTPA violations in this case. As such, the relevant requirements in this case are those that are necessary to determine penalties. As explained further below, the appropriate amount of civil penalties is not limited to Google's estimated past incremental profit from the misconducts, and the Wiggins Report also does not provide any authoritative source that makes such a claim.

24. Simply put, as I previously opined, the total penalty to Google for its misconduct cannot simply be based on the direct benefits it received from its misconduct. Rather, a substantial civil penalty in excess of the direct benefits a company gains from its misconduct is essential to deterring future misconduct, in part because a "business that faces no potential penalty beyond returning its ill-gotten gains may be tempted to engage in unfair and deceptive practices," and "[i]f

[27] *See, e.g.,* Andrien Opening Report, ¶11(h).
[28] *See, e.g.,* Andrien Opening Report, ¶100, footnote 278.
[29] For example, while Professor Wiggins states that "According to Mr. Andrien, penalties should be limited to the *incremental* benefits Google received *from the alleged deception*," *see* Wiggins Report, ¶117 (emphasis in Wiggins Report), he mischaracterizes the framework I used and suggests that I imposed certain limitations that I did not. Professor Wiggins appears to gloss over the fact that I opined that but "*one way*" to frame the appropriate amount to deter future bad behavior involves "*at a minimum,*" penalizing Google for "*at least*" the total incremental benefits (including future benefits) it gained from the alleged misconduct. *See, e.g.*, Andrien Opening Report, ¶11(f), ¶106. In other words, I opined that an incremental benefit analysis was but one way to frame the appropriate penalty amount sufficient for a deterrent effect and that any incremental benefit to Google for its alleged misconducts would merely be the starting point of such analysis, but, as explained below, I was unable to conduct a complete and accurate incremental benefits analysis because Google did not produce or does not maintain records that are complete, accurate, and reliable enough to do so, and the records that Google did produce are insufficient and unreliable.

it is caught, it simply ends up back where it started"—which is wholly insufficient to have a deterrent effect.[30] This is why the analysis I conducted discussed the direct benefits to Google from their misconducts only as a minimum baseline in considering a total penalty amount.[31] Moreover, economic literature also supports that to establish deterrence, the penalty assessed must be greater than the defendant's profits from the misconduct because the probability of being caught and found liable is less than 100 percent.[32]

25. Professor Wiggins' misunderstanding of the methodology I used undermines and invalidates his critique. Additionally, Professor Wiggins' conclusions and criticisms of the methodology I employed are based on the flawed methodology that he employs, which is inconsistent with the record in this case, including Google's own documents and testimony, as well as economic literature.

[30] *See, e.g.*, Andrien Opening Report, ¶106, footnote 282 (citing "Carolyn Carter, Consumer Protection in the States: A 50-State Evaluation of Unfair and Deceptive Trade Practices Laws, National Consumer Law Center, March 2018, at p. 30, available at https://www.nclc.org/wp-content/uploads/2022/09/UDAP_rpt.pdf, accessed 6/4/2024.) ("In almost all states, the UDAP statute allows the state to ask a court to impose a monetary penalty on a business that has engaged in an unfair or deceptive practice. A substantial civil penalty for initial violations is important because of its deterrent effect. A business that faces no potential penalty beyond returning its ill-gotten gains may be tempted to engage in unfair and deceptive practices. If it is caught, it simply ends up back where it started, but if not caught it keeps its gains. The potential of a civil penalty in addition to restitution helps balance this equation."); *see also Id.* at ¶65, footnote 183 (citing *United States v. Phelps Dodge Indus., Inc.*, 589 F. Supp. 1340, 1362 (S.D.N.Y. 1984) ("Federal courts have identified factors to consider when assessing fines under the FTCA including the good faith or bad faith of the defendants, the injury to the public, the defendants' ability to pay and the extent to which defendants have benefited from the violations, whether continuing violations have a detrimental effect on the public, whether defendant can eliminate the effects of the violation if it were motivated to do so, and the penalties awards must result in effective deterrence lest potential violators "regard the statutory penalty 'as nothing more than an acceptable cost of violation.'") *See also* Chopra, Rohit and Levine, Samuel A.A., The Case for Resurrecting the FTC Act's Penalty Offense Authority, p. 100 (noting that "[p]enalties can and should exceed ill-gotten gains," and penalties that do not exceed (or even capture) ill-gotten gains are generally too lenient, in that they are unlikely to deter others from engaging in similar misconduct . . .")

[31] For this reason, I noted in my Opening Report that many statutes allow for treble damages—far in excess of the actual financial benefits obtained from a company's misconduct—"to establish deterrence of future misconduct" and remove the financial incentive to engage in misconduct. While here the Plaintiff States are not seeking actual monetary damages for DTPA violations, the general deterrent effect of making a defendant pay significantly more than they actually earned from their misconduct similarly applies. *See* Andrien Opening Report, footnote 283.

[32] *See* § III.B. below.

26. I discuss my critiques of the Wiggins Report's methodology and conclusions in the remainder of this report.

B. The Penalties Analysis in the Wiggins Report Is Contradicted by the Economic Literature on Deterrence and Does Not Appropriately Assess the Amount Necessary to Deter Improper Conduct

27. The Wiggins Report criticizes the range of civil penalties I propose in my Opening Report, characterizing them as "wildly disproportionate" and a departure from the "framework" I utilized.[33] The Wiggins Report proposes two alternative total penalty amounts.[34] First, it suggests that the total penalty should be no greater than $44.9 million, based on reducing the violation counts and penalty per violation quantified in my Opening Report.[35] Second, it suggests that the total penalty should be no greater than $21.7 million, based on Professor Wiggins' estimates of Google's incremental profit from the alleged misconduct.[36] As I discuss in Section III.C. below, both these alternatives vastly understate the benefits to Google from the alleged misconduct. But first, I discuss that the Wiggins Report largely ignores that deterrence is explicitly a factor to consider in the statutes and/or case law of various Plaintiff States, fails to provide any meaningful response to my opinions regarding the amount of civil penalties necessary to deter Google (and others) from engaging in similar misconduct in the future, and further fails to establish that the amount of penalties he proposes is sufficient to deter future misconduct by Google and others. Moreover, as I discuss below, Professor Wiggins' assertions that the amount of penalties is tied to Google's direct benefit from the misconduct is inconsistent with economic literature.

[33] *See* Wiggins Report, §VII, ¶258.
[34] The Wiggins Report also includes a $141.3 million penalty estimate based on only "partial" corrections. *See* Wiggins Report, Figure 6.
[35] Wiggins Report, ¶¶18, 256.
[36] Wiggins Report, ¶¶19, 257.

28. As I described in my Opening Report, deterrence is not only explicitly listed as a relevant factor in determining penalties under the statutes of certain states, but also under developed case law.[37] It is instructive to note that where such factors are explicit, whether through codification, case law, or reference to federal statute, they consistently contemplate the deterrent effect of the penalty to prevent future violations.[38] The Wiggins Report does not challenge that deterrence is a relevant factor to consider in determining the amount of the penalty. Professor Wiggins also fails to establish that his proposed penalties would deter Google and others from future misconduct, which they will not.[39]

29. Below, I discuss how economic theory, including Nobel Prize-winning research, establishes that a penalty can and should exceed the gain from the alleged misconduct, including research that suggests that when a wealthy offender is apprehended, the optimal penalty to establish deterrence should be maximal, i.e. as much as the offender can bear.

30. The economic theory of crime deterrence is a well-established discipline within the field of economics, dating back to the 18th century.[40] Although scholars like Montesquieu, Beccaria, and Bentham applied economic principles to public law enforcement in the mid-to late-1700s, Nobel laureate Gary Becker is typically credited with modernizing longstanding ideas in

[37] *See, e.g.,* Andrien Opening Report, § III.E. I also understand that deterrence is a considered in assessing penalties for unfair or deceptive trade practices under the Federal Trade Commission Act ("FTCA"), which is referenced for guidance in the statutes of various Plaintiff States. *See, e.g.,* Rohit Chopra & Samuel A. Levine The Case for Resurrecting the FTC Act's Penalty Offense Authority, 170 U. Pa. L. Rev. 71 at pp. 99-104 (2021).

[38] *See, e.g.,* Andrien Opening Report at p. 35, fn 180 (citing Missouri court stating that penalties were "appropriate in view of the magnitude and seriousness of the violations … the lack of a bona fide error, and the need to deter"); pp. 38-39 (citing South Carolina case law listing "the deterrence value of the assessed penalties" as a factor to consider in assessing penalty amounts); p. 40 (citing Texas statute listing "the amount necessary to deter future violations" as a factor to consider in assessing penalty amounts); p. 41 (citing Utah statute listing "the need to deter the supplier or others from committing the violation in the future" as a factor to consider in assessing penalty amounts).

[39] *See, e.g.*, Chopra, Rohit and Levine, Samuel A.A., The Case for Resurrecting the FTC Act's Penalty Offense Authority, p. 99 (stating that civil penalties "are intended not only to punish the wrongdoer but also to deter others from engaging in similar misconduct") (citations omitted).

[40] Polinsky, Mitchell and Steven Shavell, "The Theory of Public Enforcement of Law" *Handbook of Law and Economics*, Volume I (2007), p. 405; Raskolnikov, Alex, Deterrence Theory: Key Findings and Challenges, p. 179.

this area by framing them in "formal economic terms."[41] In 1968, Dr. Becker published a seminal paper on the subject, *Crime and Punishment: An Economic Approach*, which was later instrumental in winning him the Nobel Prize in Economics.[42] Dr. Becker's work applied free-market principles to the question of why people commit crimes, arguing that the way to reduce crime was to make the costs outweigh the benefits.[43] Since Dr. Becker's seminal paper, a significant body of scholarship on the economics of deterrence has developed.[44] My review of this body of literature establishes that limiting the amount of the penalty to Google's incremental profit from the alleged misconduct is wrong and inconsistent with standard economic theory. I also have reviewed Dr. DeRamus' Reply Report and there is nothing in his report that conflicts with my analysis of the deterrence issue.[45] Moreover, it is my opinion that not only would such a limited penalty be insufficient to provide the macro-level deterrent effect that governments seek to establish, but that it would also be insufficient to provide even a micro-level deterrent effect on an apprehended offender—in this case, Google.

31. In the context of "public enforcement of the law… deterrence refers to preventing socially harmful conduct."[46] Scholarship on this subject seeks to optimize how the government can achieve the objective of maximizing social welfare, which is typically defined as "the benefits that individuals obtain from their behavior, less the costs that they incur to avoid causing harm, the harm that they do cause, the cost of catching violators, and the costs of imposing sanctions on

[41] *See* Polinsky, Mitchell and Steven Shavell, "The Theory of Public Enforcement of Law" *Handbook of Law and Economics*, Volume I (2007), p. 407; Raskolnikov, Alex, Deterrence Theory: Key Findings and Challenges, p. 180.
[42] https://www.nobelprize.org/prizes/economic-sciences/1992/press-release/.
[43] https://www.chicagobooth.edu/faculty/nobel-laureates/gary-becker.
[44] Raskolnikov, Alex, Deterrence Theory: Key Findings and Challenges; Polinsky, Mitchell and Steven Shavell, "The Theory of Public Enforcement of Law" *Handbook of Law and Economics*, Volume I (2007).
[45] Report of Dr. David DeRamus, September 9, 2024 ("DeRamus Report").
[46] Raskolnikov, Alex, Deterrence Theory: Key Findings and Challenges, p. 179.

them (including any costs associated with risk aversion)."[47] In general, this framework can provide the bases for deterring not just the apprehended offender from committing future offenses, but also all other potential offenders.[48]

32. The government's decision variables to achieve optimal outcomes include: (i) its expenditures on enforcement, which help determine the probability of detection ("p"); (ii) the magnitude of the sanctions ("f"); and (iii) the form of the sanctions (fines, imprisonment, etc.).[49] I address each of these factors below.

33. In terms of determining the form of the sanction, the economic literature recognizes that fines offer several advantages over other forms of sanctions and encourages the use of fines "*whenever feasible*."[50] Specifically, fines are relatively cheaper to impose than other types of sanctions, punish offenders and compensate society, and simplify optimizing the combination of the probability of detection and the magnitude of the sanction.[51]

34. Next, the probability of detection "is a compound probability that the offense is detected, that the enforcement agents decide to litigate/prosecute the case (rather than to ignore it in order to focus on other, more severe violations), and that the parties do not resolve the

[47] *See* Polinsky, Mitchell and Steven Shavell, "The Theory of Public Enforcement of Law" *Handbook of Law and Economics*, Volume I (2007), p. 406. I note that there is a dispute amongst economists about whether social welfare should include the gains of the offender. While Becker, Polinsky and Shavell include the offenders gains in their framework, others—including Nobel Laureate George Stigler—have argued against this notion. This dispute is not settled. *See*, e.g. Raskolnikov, Alex, Deterrence Theory: Key Findings and Challenges, pp. 180-181. For the purposes of this discussion, I assume that an offender's gains are included in social welfare. However, excluding an offender's gains from consideration makes higher sanctions, as well as a higher probability of detection more desirable. *See*, Polinsky, Mitchell and Steven Shavell, "The Theory of Public Enforcement of Law" *Handbook of Law and Economics*, Volume I (2007), p. 408.
[48] Chopra, Rohit and Levine, Samuel A.A., The Case for Resurrecting the FTC Act's Penalty Offense Authority, p. 99.
[49] *See* Becker, Gary, "Crime and Punishment: An Economic Approach" *Journal of Political Economy* (1968), p. 43; *See* Polinsky, Mitchell and Steven Shavell, "The Theory of Public Enforcement of Law" *Handbook of Law and Economics*, Volume I (2007), p. 407.
[50] *See* Becker, Gary, "Crime and Punishment: An Economic Approach" *Journal of Political Economy* (1968), p. 28.
[51] Becker, Gary, "Crime and Punishment: An Economic Approach" *Journal of Political Economy* (1968), pp. 43-44.

controversy through settlement which may or may not include a payment."[52] Additionally, "[p]ublic enforcement is often characterized by low probabilities of detection,"[53] and "Moreover, the likelihood that an offender will be discovered and convicted and the nature and extent of punishments differ greatly from person to person and activity to activity."[54] I note that Google's failure to preserve and produce relevant information subject to litigation holds, which is at issue in this litigation and several other litigations, further reduces the probability of detection and increases the costs of enforcement absent sufficient remedial action by the Court.[55]

35. It is well understood in the economic literature that: (i) the optimal penalty from a macro (or social welfare perspective) depends on the external harm caused by the misconduct, not the offender's expected gain[56] and (ii) the combination of the probability of detection and the

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[52] *See* Raskolnikov, Alex, "Deterrence Theory: Key Findings and Challenges," p. 182 and footnote 3.
[53] *See* Polinsky, Mitchell and Steven Shavell, "The Theory of Public Enforcement of Law" *Handbook of Law and Economics*, Volume I (2007), p. 421; Chopra, Rohit and Levine, Samuel A.A., The Case for Resurrecting the FTC Act's Penalty Offense Authority, p. 99.
[54] *See* Becker, Gary, "Crime and Punishment: An Economic Approach" *Journal of Political Economy* (1968), pp. 1-2.
[55] I understand that in this lawsuit, after the Plaintiff States moved to compel written discovery regarding Google's destruction of Google Chats, the Special Master concluded that [redacted] *See* Order of Special Master, July 15, 2024, at p. 11. In addition, at least two federal judges have found that Google has engaged in improper conduct related to the preservation and production of relevant information subject to litigation holds. In the Google Play Store Antitrust Litigation, Judge Donato determined that it was "clear in the record that relevant, substantive business communications were made on Chat that plaintiffs will never see, to the potential detriment of their case." *See*, United States District Court Northern District of California, *In Re: Google Play Store Antitrust Litigation*, Findings of Fact and Conclusions of Law Re Chat Preservation, Case No. 21-md-02981-JD, March 28, 2023, p. 18. In a hearing on the issue, Judge Donato stated "I have just never seen anything this egregious… this conduct is a frontal assault on the fair administration of justice. It undercuts due process, and it calls into question the just resolution of legal disputes. It's antithetical to our system." *See*, Case 3:20-cv-05671-JD Document 591, December 6, 2023, pp. 163-164.
Similarly, in the DOJ's search antitrust case against Google, Judge Mehta stated that "the court is taken aback by the lengths to which Google goes to avoid creating a paper trail for regulators and litigants. It is no wonder then that this case has lacked the kind of nakedly anticompetitive communications seen in Microsoft and other Section 2 cases… Google clearly took to heart the lessons from these cases. It trained its employees, rather effectively, not to create 'bad' evidence." *See*, United States District Court for the District of Columbia, *United States v. Google LLC*, Case No. 20-cv-3010 (APM), Memorandum Opinion, August 5, 2024, p. 275.
[56] *See* Polinsky, Mitchell and Steven Shavell, "The Theory of Public Enforcement of Law" *Handbook of Law and Economics*, Volume I (2007), pp. 408, 413-414; Raskolnikov, Alex, "Deterrence Theory: Key Findings and Challenges," p. 182; *see also* Chopra, Rohit and Levine, Samuel A.A., The Case for Resurrecting the FTC Act's Penalty Offense Authority, p. 99 (noting that merely awarding an amount directly lost by victims or earned by wrongdoers as relief "can underdeter serious wrongdoing, especially when the consequences of that wrongdoing are difficult to calculate, or far exceed direct losses or gains.").

magnitude of the sanction is "one of the key payoffs of optimal deterrence theory."[57] Focusing solely on the harm to society, rather than the expected benefits to the offender, leads to a penalty that incentivizes the offender to commit only wrongful acts in which their expected gain exceeds social harm.[58] Ultimately, to deter future misconduct, appropriate fines must be larger than the harm, because the probability of detection is less than one.[59] Specifically, "[t]he standard response to the problem of imperfect detection is to increase the nominal (that is, statutory) sanction by the so-called multiplier, making sure that the expected sanction equals the act's external harm."[60]

36. However, economists also recognize that increasing the probability of detection requires incurring more costs to catch offenders (thus, it negatively affects social welfare).[61] Moreover, the more money is spent on detection efforts, the less benefit each additional dollar of expenditure will produce. Thus, beyond a certain level of spending, increasing fines rather than enforcement spending becomes a more socially efficient deterrence strategy because achieving the same level of deterrence would require a smaller adjustment in the fine and a larger adjustment in enforcement spending to increase the probability of detection.[62] Polinsky and Shavell go so far as to state that, under certain conditions, "**the optimal fine is maximal**" and cannot be less than the wealth of the offender.[63] But the concept of tying the fine to the wealth of the offender is not a new

[57] *See* Raskolnikov, Alex, "Deterrence Theory: Key Findings and Challenges," p. 182.
[58] *See* Polinsky, Mitchell and Steven Shavell, "The Theory of Public Enforcement of Law" *Handbook of Law and Economics*, Volume I (2007), pp. 408, 413; Raskolnikov, Alex, "Deterrence Theory: Key Findings and Challenges," pp. 180, 182.
[59] *See* Raskolnikov, Alex, "Deterrence Theory: Key Findings and Challenges," p. 182.
[60] Raskolnikov, Alex, "Deterrence Theory: Key Findings and Challenges," p. 182; *See* Polinsky, Mitchell and Steven Shavell, "The Theory of Public Enforcement of Law" *Handbook of Law and Economics*, Volume I (2007), pp. 408, 413.
[61] Becker, Gary S. "Crime and Punishment: An Economic Approach." *Journal of Political Economy* 76, no. 2 (1968): pp. 174, 180-181.
[62] Becker, Gary S. "Crime and Punishment: An Economic Approach." *Journal of Political Economy* 76, no. 2 (1968): pp. 177-178, 183-185.
[63] I note that Polinsky and Shavell point out that "[o]ptimal sanctions might not be maximal, however, when individuals are risk averse in wealth or risk preferring in imprisonment…" *See* Polinsky, Mitchell and Steven Shavell, "The Theory of Public Enforcement of Law" Handbook of Law and Economics, Volume I (2007), pp. 413-414, 420.

idea. As early as 1780s, Jeremy Bentham wrote that "[a] pecuniary punishment, if the sum is fixed, is in the highest degree unequal…Fines have been determined without regard to the profit of the offense, to its evil, or to the wealth of the offender…Pecuniary punishments should always be regulated by the fortune of the offender. The relative amount of the fine should be fixed, not its absolute amount; for such an offense, such a part of the offender's fortune."[64]

37. I understand however, that in certain circumstances, society may choose to deter certain behaviors without explicitly considering, or regardless of the impact on, net social welfare. For example, I understand that the statutes under which the Plaintiffs States brought this lawsuit call for penalties that deter the types of conduct that Google has committed in this case. In such cases, if the offender's gain exceeds the external harm, a penalty based on the external harm will be insufficient to deter future misconduct. This is because the expected value of the benefit in such cases will always exceed the expected penalty. Therefore, to determine the appropriate penalties to levy against Google in this case, it can also be informative to consider the gain achieved by Google because of its misconduct. The standard multiplier approach described above is still applicable, except that the penalty should be set such that the expected penalty equals the offender's benefit rather than the external harm. The penalty set in this manner will also be larger than the benefit to the offender, given that the probability of detection, once again, is less than one. Therefore, limiting the fine in this case to the benefit Google has derived from the misconduct, as Professor Wiggins suggests, is economically insufficient to deter Google from such conduct, let alone other potential offenders. Moreover, one would have to be able to, with reasonable precision, determine the benefit to Google, which Professor Wiggins has not done, and Google testimony

[64] The quote is from Richard Hildreth's 1864 english translation of Étienne Dumont's *Traités* de *législation* civil et *pénale* (1802), titled *Theory of Legislation; by Jeremy Bentham*, London: Trübner & Co (1864), p. 353.

suggests is not possible.[65] I address the challenges to calculating Google's benefits in my Opening Report, and below.[66]

38. The Wiggins Report and Skinner Report appear to have ignored the economic literature on deterrence, which not only supports the approach I have taken, but also suggests my conclusions are conservative. This literature is also consistent with the three factors I analyzed in determining statutory penalties and the analysis presented in my Opening Report. More specifically, I have analyzed Google's wealth. I analyzed Google's worldwide revenues and profits, its U.S. revenues and profits, its revenues and profits allocable to the 17 Plaintiff States, and its revenues and profits allocable to various business segments. I have analyzed Google's history of fines and settlements for similar conduct, which appear to have been insufficient to deter other misconduct. I have analyzed Google's ability to pay a fine at the high end of my proposed range. Even the highest penalty I propose is far less than the maximal amount that Google can pay. Specifically, a $21.81 billion total penalty is merely 1.2 percent of Google's net worth as measured by its market capitalization ($1.86 trillion as of September 6, 2024),[67] 5.6 percent of Google's net income between 2013 through 2023 ($390.51 billion),[68] 21.7 percent of cash and short-term investments ($100.73 billion as of June 30, 2024).[69] Similarly, Google documents indicate that even a contract like the Network Bidding Agreement ("NBA"), which internally Google employees considered to be a "multibillion-dollar deal with long-term impact to Google and the broader ads ecosystem"[70] that addressed the "existential threat posed by Header Bidding and FAN

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[65] *See* § III.C.
[66] *See* § III.C; Andrien Opening Report, § IV.F.
[67] Andrien Opening Report, ¶84.
[68] Andrien Opening Report, ¶80.
[69] Andrien Opening Report, ¶81; S&P Capital IQ; Alphabet Inc. SEC Form 10-Q for the quarterly period ended June 30, 2024.
[70] GOOG-AT-DOJ-01901774 at -777.

['Facebook Audience Network']."[71] [redacted]

39. Even though my analysis is supported by the economic literature and specified within the factors to consider in relevant state statutes, Professor Wiggins and Professor Skinner ignore these factors.[75] They provide no basis or explanation of why they ignored these factors, nor for why these factors should be ignored.

40. To reiterate, I have determined reasonable and conservative deceptive trade practices civil penalties based on the subset of factors I considered. My proposed penalty ranges are based upon the violation counts articulated in my initial report.[76] [redacted] it is my opinion that such a decrease in violation counts would not result in a linear reduction in the total penalty amount and, at the very least, would result in an appropriate civil penalty being at the lower end of a proffered range (e.g. $7.27 billion for Bernanke).[78] Google has engaged in serious misconduct over a period of years, deriving significant short- and long-

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[71] GOOG-NE-05311570 at -570.
[redacted]
[75] Skinner Report, §IX; Wiggins Report, §VIII.B.
[76] *See* Andrien Opening Report, Table 4.
[77] *See* § III.E.
[78] The same applies to Google's RPO, DRS, and Equal Footing conducts – a decrease in violation counts would not result in a linear reduction in the total penalty amount related to those misconducts and, at the very least, should result in an appropriate civil penalty at the lower end of my proffered range.

term benefits from their actions, which are not fully reflected in an analysis of direct incremental benefits. Given the body of academic literature I have reviewed, the likely incomplete production of all relevant evidence by Google, and the complexity of the underlying auction mechanics, it is logical that the probability of detection is low in this instance.[79] In the parlance of the economic theory of deterrence, if the probability of detection is relatively low, the optimal fine for deterrence should be high.

C. The Wiggins Report Contains an Incorrect Assessment of Google's Benefit from Its Misconduct

a. The Wiggins Report's Incremental Profit Analysis is Flawed and Unreliable

41. The Wiggins Report undertakes a purported "direct assessment" of Google's incremental benefits from the alleged deception of each program. As I discussed above, while this may be a consideration for determining an appropriate penalty under a holistic approach, Professor Wiggins' analysis is nevertheless flawed and unreliable.

42. The Wiggins Report states that in undertaking his purported "direct assessment," he "emphasize[s] that benefits from the alleged deception are conceptually different from benefits from the programs in question."[80] The Wiggins Report performs an assessment in two ways: first by conceptually addressing "the extent to which Google profited from the alleged deception about each program," and second by performing "an empirical analysis that assumes that advertisers and publishers do not learn and adapt their strategies in response to the feedback they receive in the marketplace."[81]

[79] *See also* DeRamus Report, § VI.B.
[80] Wiggins Report, ¶184.
[81] Wiggins Report, ¶185.

43. The Wiggins Report's "empirical" analysis results in estimated incremental revenue and profits calculations for Bernanke, DRS v1, DRS v2 and RPO.[82] However, the calculations suffer from three primary deficiencies: 1) Google itself represented that such calculations may not be possible to perform, 2) the calculations contradict information Google employees provided about the direct incremental benefits of each program, and 3) the calculations do not account for the significant indirect benefits derived by Google from violating DTPA statutes.

i. Google represented that an evaluation of incremental benefits may not be feasible to perform.

44. The Wiggins Report fails to acknowledge that the precision of any analyses (including its own) of the direct, indirect, and incremental benefits of Google's alleged misconducts, as well as the profits and revenues associated therewith, necessarily depends on complete and accurate data and other information, which here, Google did not produce and admits it does not maintain. Notably, it appears that the Wiggins Report does not refer to, rely upon, or even acknowledge the existence of the Declaration of [redacted] – a Google software engineer and member of Google's Ad Manager Reporting and Insights Team since 2013,[83] who is "responsible for building pipelines to digest historical data and produce analytics and insights," and "familiar with the tools available at Google to access, search, and store data in Google's ad logs"[84] – which Google submitted in support of its Amended Responses to Plaintiffs' Third Set of Interrogatories.[85] Indeed, [redacted] declared under oath that Google did not maintain datasets responsive to certain of Plaintiff States' requests for financial and other data related to Google's

[82] Wiggins Report, Appendix D.
[83] [redacted] Declaration, ¶1.
[84] [redacted] Declaration, ¶1.
[85] Defendant Google LLC's Responses to Plaintiffs' Third Set of Interrogatories, May 24, 2024.

deceptive programs (including but not limited to RPO, DRS, and Bernanke) and necessary for such a calculation.[86]

45. It is my understanding that the Plaintiff States have issued requests for information related to the number of impressions affected by certain Google programs at issue in this litigation (including RPO, DRS, and Bernanke), Google revenue and profits attributable to these programs, and any additional value gained by Google related to these programs.

46. Specifically, I understand that on April 1, 2024, the Plaintiff States requested discovery data and information on a monthly basis dating back to January 1, 2013, for each of "Google's Auction Mechanics" (defined to include RPO, DRS, and Project Bernanke among others).[87] For each such program, the Plaintiff States requested "the number of impressions where such Google Auction Mechanic had any effect on bids, floor prices, or revenue shares, and the percentage of such impressions as a share of overall impressions, which otherwise would not have been affected had the Google Auction Mechanic not been operational,"[88] "the number and percentage of AdX auctions on which the Google Auction Mechanic had an effect on bids, floor prices, revenue shares, or margins, which otherwise would not have been affected had the Google Auction Mechanic not been operational,"[89] "Google's revenues and profits attributable to such Google Auction Mechanic,"[90] and "any additional value gained by [Google], including in the form of improved position or share in any and all Ad Tech Product markets."[91]

[86] [redacted] Declaration, ¶¶5, 6, 9.
[87] *See* Plaintiff State of Texas's Third Set of Interrogatories, April 1, 2024; *see also* [redacted] Declaration.
[88] *See* Plaintiff State of Texas's Third Set of Interrogatories, April 1, 2024 at Interrogatory 7; *see also* [redacted] Declaration, ¶3.
[89] *See* Plaintiff State of Texas's Third Set of Interrogatories, April 1, 2024 at Interrogatory 8; *see also* [redacted] Declaration, ¶3.
[90] *See* Plaintiff State of Texas's Third Set of Interrogatories, April 1, 2024 at Interrogatory 10; *see also* [redacted] Declaration, ¶3.
[91] *See* Plaintiff State of Texas's Third Set of Interrogatories, April 1, 2024 at Interrogatory 11; *see also* [redacted] Declaration, ¶3.

47. In addition, also on April 1, 2024, the Plaintiff States requested data associated with Project Bernanke, on a monthly basis dating back to the inception of Project Bernanke, including the number of auctions (as a count and a percentage of overall auctions) where the operation of Bernanke resulted in a winning bid and the average and median monetary amount such bids were adjusted by the operation of Bernanke; the number of auctions (as a count and a percentage of overall auctions) in which Bernanke raised or lowered the second-highest bid submitted to the AdX auction, the number of bids (as a count and a percentage of overall auctions) in which the second-highest bid was lowered to zero or the minimal increment above zero, and the average monetary amount such bids were adjusted by the operation of Bernanke; the number of queries won due to Bernanke in which the winning bid was raised above a competing bid in the AdX auction and the number of queries won due to Bernanke in which the highest bid raise raised above only the publisher's floor price, and the average monetary amounts the winning bids were above the floor price or the next-highest bid; the average and median values for Bernanke alpha and beta; the number of auctions (as a count and a percentage of overall auctions) where the operation of Bernanke resulted in money being contributed to one or more Bernanke pools and the average amount of such contribution; the number and identity of publishers for whom the operation of Bernanke had a negative impact on revenue, and the amount of such negative impact; the number and identity of publishers that were excluded from the Bernanke program and the reasons for their exclusion; the identity of any publishers for whom Google monitored margins for the purpose of ensuring that Bernanke did not have a negative impact on these publishers' revenue; any efforts, programs, initiatives, or monitoring Google engaged in or otherwise performed to determine the impact of Bernanke on floor prices set by publisher.[92]

[92] *See* Plaintiff State of Texas's Third Set of Interrogatories, April 1, 2024 at Interrogatory 12. *See* also [redacted] Declaration, ¶4.

48. I understand that on May 1, 2024, Google initially objected to these requests and responded that it could not "reasonably respond" to them "at this time," but that it was willing to meet-and-confer on the requests.[93] I further understand that on May 24, 2024, Google provided Amended Responses and Objections to the aforementioned requests, in which it responded to each request, in part, that [redacted][94,95]

49. I further understand that on the same day, Google tendered the sworn declaration of [redacted] in support of Google's amended responses to the Plaintiff States' requests for financial and other data related to Google's deceptive programs (including but not limited to RPO, DRS, and Bernanke),[96] in which [redacted] declared that he is "[redacted]

[93] *See* Google's Responses to State of Texas's Third Set of Interrogatories, May 1, 2024 at Interrogatories 7-8, 10-12.
[94] Google's First Amended Responses to State of Texas's Third Set of Interrogatories, May 24, 2024 at Interrogatories 7-8, 10-12 (emphasis added).
[95] For example, in Interrogatory 10, the Plaintiff States requested that Google identify its revenues and profits attributable to each Google Auction Mechanic (e.g., DRS, Bernanke, and RPO) from January 2013 to present. Google responded to this request noting the significant challenges of performing such an evaluation, stating [redacted]
[96] *See generally* [redacted]

[redacted][98,99]

50. I understand that this information has not, to date, been produced by Google. Moreover, Google itself has represented that an evaluation of incremental benefits might not even be possible, a fact the Wiggins Report seemingly disregards.

51. In addition, Google personnel have testified at deposition as to the challenges inherent in such an exercise. For example, Nirmal Jayaram, a Google Software Engineer who served as a 30(b)(6) witness, testified about the inherent difficulty of evaluating the incremental benefits of a given program.[100]

[redacted]

[97] [redacted] Declaration, ¶5.
[98] [redacted] Declaration, ¶9 (emphasis added).
[99] Specifically, [redacted] declared that [redacted] *See* [redacted] Declaration, ¶6.
[100] *See* Deposition of Nirmal Jayaram, April 26, 2024 ("Jayaram Deposition") at 139:12-140:6 (emphasis added).

[redacted]

52. Mr. Jayaram further testified that [redacted]

[redacted]

54. To the extent the Professor Wiggins is aware of Google's representations about the difficulty inherent in identifying its revenues and profits attributable to each Google Auction Mechanic (i.e., [redacted] he is silent about it in his report. If Professor Wiggins is aware of the testimony or declarations of Google personnel such as Mr. Jayaram and [redacted] as to the

[101] *See* Jayaram Deposition at 142:14-25 (emphasis added).
[102] *See* Jayaram Deposition at 265:4-12 (emphasis added).

difficulty of this task, he is similarly silent about it in his report. In other words, while Google admits that an evaluation of incremental benefits might not even be possible, and that it does not maintain the data necessary to precisely determine the number of auctions directly affected by, the revenues and profits associated with, or the additional value it gained through its auction manipulation programs, the Wiggins Report appears to completely disregard these facts. To that end, Professor Wiggins' failure to reconcile his purported "direct assessment of Google's benefits" to the representations and testimony of Google and its personnel renders his analysis speculative and unreliable.

ii. *The Wiggins Report's Calculations Contradict Information Regarding the Incremental Benefits of the Programs Provided by Google's Own Personnel*

55. Below, I provide examples of how the Wiggins Report's estimates of incremental profit related to Google's misconduct contradict information on the incremental benefits of this conduct as provided by Google's own personnel. As I explained in my Opening Report, I find that Google's internal estimates are unreliable and insufficient to support an analysis of the direct benefit of the misconduct to Google;[103] however, the fact that the Wiggins Report's proffered results are lower than some of these incomplete estimates and that he has not done any analysis to account for these variances show that his calculations are unreliable.

56. Regarding Bernanke, [redacted]

[103] Andrien Opening Report, footnote 285 ("There are documents in the record that provide estimates of the direct monetary impact related to Google's misconduct. When asked to provide 'Google's revenue and profits attributable to such Google Auction Mechanic' Google has stated that they 'would need to attempt to create this data through a manual process.' *See* [redacted] in Support of Defendant Google LLC's Responses to Plaintiffs' Third Set of Interrogatories, May 24, 2024. Google has not undertaken this process. Thus, I find these limited documents unreliable and insufficient to support an analysis of the direct benefit of the misconduct to Google. Further, as I describe herein, Google's benefit from the misconduct is not limited to the direct monetary benefit of each misconduct.")

[redacted] In contrast to the Wiggins Report's calculation, Google prepared an internal presentation nearly two years after the launch of Project Bernanke in August 2015 [redacted]

57. [redacted]. Professor Wiggins' failure to reconcile his estimated incremental benefits with Google's own internal estimate renders his calculations speculative and unreliable.

58. [redacted] This calculation, once again, contradicts estimates from Google personnel, in this case, Nitish Korula, a Senior Technical Adviser and Google employee for approximately 14 years, who from July 2016 through December 2021, was a lead for "engineering teams developing Google products that allow publishers to sell

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[104] [redacted]

[106] [redacted]

[107] Wiggins Report, ¶¶304-318.

display advertising inventory, including Google Ad Manager."[108] During the deposition of Mr. Korula, he estimated that [redacted]

59. [redacted]. As with the Bernanke example, Professor Wiggins is again silent as to Google's own documents and testimony, which he did not consider. Accordingly, Professor Wiggins' failure to reconcile his estimated incremental benefits with Google's own internal estimates render his calculations speculative and unreliable.

iii. The Wiggins Report's Calculations Do Not Account for the Significant Indirect Benefits Derived by Google from Violating DTPA Statutes

60. As discussed in the next section, Google accrued numerous indirect benefits from violating the DTPA statutes, none of which are accounted for in the Wiggins Report's incremental profit calculations. For example, Google's misconduct provides funds which could be used for additional employees, improvements in technology, or to improve the company's relative position in the industry.[111] Google's misconduct also results in indirect network effects that serve as barriers to entry against competitors and create difficulties for competitors trying to compete with Google's

[108] *See* GOOG-AT-MDL-008842393; Declaration of Nitish Korula, August 4, 2023, ¶1.
[109] Deposition of Nitish Korula, July 12, 2024 at 190:2-23.
[redacted] of each Plaintiff State's internet population to that of the United States as a whole from 2013-2023.
[111] *See* § III.C.b.

dominant display advertising position.[112] Further, increased AdX win rates and revenue from the deceptive misconduct results in attracting more publishers and advertisers to Google's platform, furthering Google's dominance.[113] Finally, as Google grows and dominates the display advertising market by way of the alleged misconduct, Google aims to use the data gathered along the way to enhance and grow its other offerings, such as with the "Narnia 2.0" program.[114] Professor Wiggins does not consider any of these indirect benefits in his incremental profits calculation. Because he does not identify and isolate the impacts of the misconducts in all the other areas of Google's business, his incremental profit calculations are speculative and unreliable.

b. The Wiggins Report Disregards the Significant Indirect Benefits Derived by Google from Violating DTPA Statutes

61. The Wiggins Report claims that "There are no indirect benefits that would justify higher DTPA penalties."[115] However, this response fails for myriad reasons.

62. First, the Wiggins Report suggests that "indirect network effects" that serve as barriers to entry against competitors are irrelevant as they do "not relate to the alleged deception."[116] Interestingly, Professor Wiggins does not dispute the underlying notion that these indirect network effects would indeed serve as barriers to entry against competitors. Professor Wiggins misses the fact that, due to indirect network effects, increased AdX win rates and revenue from the deceptive DTPA misconducts results in attracting more publishers and advertisers to Google's platform, furthering Google's dominance. The Plaintiff States' allegations in this case include antitrust claims in addition to the DTPA claims. While separate and distinct, these allegations relate in some ways to similar conduct (for example, Project Bernanke) and in the sense

[112] *See* § III.C.b.
[113] *See* § III.C.b.
[114] *See* § III.C.b.
[115] Wiggins Report, p. 122.
[116] Wiggins Report, ¶264.

that each type of misconduct has the ability to enhance the other. Google references this phenomenon in its internal documents. [redacted][117]

63. Additionally, as Google grows and dominates the display advertising market by way of the alleged DTPA misconducts, [redacted]

64. The Wiggins Report also disregards that my opinions with respect to AdX win rates and revenue, as well as indirect network effects, are informed by the opinions of Dr. Weinberg and Dr. Gans. To wit, Dr. Weinberg opines that the benefit to Google from RPO, DRS and Project Bernanke included increased AdX win rates and revenue, as well as decreased win rates and revenues for non-AdX exchanges.[120] Dr. Gans states, "a positive feedback loop can lead to market

[117] GOOG-TEX-00124296 at -503.
[118] GOOG-TEX-00124296 at -319.
[119] GOOG-TEX-00124296 at -319.
[120] Expert Report of Matthew Weinberg, June 7, 2024 ("Weinberg Report"), § 7.E.; § 8.F, § 9.C. I note that Dr. Weinberg observes that the effect of RPO on the AdX win rate may be ambiguous as it depends on the effectiveness of the program because RPO has certain offsetting factors on auction win rates. However, according to Dr. Weinberg, it is reasonable to expect Google, a sophisticated seller with access to significant amounts of data, to be achieve this. Google documents indicate Dr. Weinberg's intuition is correct. Not only did Google expect to RPO to

dominance."[121] Dr. Gans continues, saying that "In the presence of strong network effects, a firm that controls a widely adopted product or platform may be able to maintain its market position even in the face of competition, as users may be reluctant to switch to a rival product with a smaller user base."[122] Finally, Dr. Gans states "This can create barriers to entry for new competitors and allow the incumbent firm to exercise market power by raising prices, reducing quality, or limiting innovation."[123]

65. Second, the Wiggins Report disregards the substantial indirect benefits which accrued to Google over the relevant timeframe. While I do reference in my report certain historical acquisitions by Google (e.g., DoubleClick for $3.1 billion in 2008, Invite Media for $81 million in 2010, and Admeld for $400 million in 2011)[124] which occurred prior to the deceptive acts at issue in this case, these acquisitions are properly viewed within the context of an overall scheme by Google to dominate and maintain its place in the display advertising industry.

66. For example, Google's DoubleClick acquisition included the publisher ad server DoubleClick for Publishers ("DFP") and a nascent ad exchange (which became AdX)[125] – in 2018

increase its revenues and profits, but it was, in fact, successful in deploying RPO effectively. [redacted].

[121] Expert Report of Dr. Joshua Gans, June 7, 2024 ("Gans Report"), ¶304. [redacted]

[122] Gans Report, ¶304.

[123] Gans Report, ¶304. For reference, further discussion of how Google's misconduct enhanced its monopoly power in one or more markets can be found in the Gans Report, ¶859.

[124] How Three Mergers Buttressed Google's Ad Tech Monopoly, Per DOJ, Tech Policy Press (March 9, 2023), **https://www.techpolicy.press/how-three-mergers-buttressed-googles-ad-tech-monopoly-per-doj/**.

[125] "Google Buys DoubleClick for $3.1 Billion," The New York Times, April 14, 2007, available at **https://www.nytimes.com/2007/04/14/technology/14DoubleClick.html**, accessed 8/21/2024.

the two products merged under the Google Ad Manager ("GAM") umbrella.[126] I understand that Dr. Gans concludes that Google has monopoly power in both the market for publisher ad servers through DFP and in the market for ad exchanges through AdX,[127] and that Google has anticompetitively tied those two products together.[128] Through the acquisition, Google also acquired DoubleClick's Bid Manager product, which in 2018 became part of DV360, Google's ad buying tool for large advertisers.[129] At the time of the DoubleClick acquisition, Google stated that "the combination of the two companies will accelerate the adoption of Google's innovative advances in display advertising."[130] In hindsight, the acquisition turned out to be a key piece of Google's overall success. [redacted], a former Google executive involved in the DoubleClick acquisition, stated that the deal was "a total game changer, a crucial piece in the larger jigsaw puzzle Google put together."[131] Brian O'Kelley, founder of AppNexus, stated, "had DoubleClick not gone to Google," he said, "it's not clear that Google would have been the power it became — certainly not as easily."[132] William E. Kovacic, former FTC Commissioner, stated "If I knew in 2007 what I know now, I would have voted to challenge the DoubleClick acquisition."[133]

67. Additionally, as stated in my Opening Report, Google's DTPA misconducts provided funds which could be used for additional employees, improvements in technology, or to

[126] "Introducing Google Ad Manager," Google Blog, June 27, 2018, available at **https://blog.google/products/admanager/introducing-google-ad-manager/**, accessed 8/21/2024.
[127] Gans Report, § V.C § V.D, and § VI.
[128] Gans Report, § VI.
[129] "Introducing Google Marketing Platform," Google Blog, June 27, 2018, available at **https://blog.google/products/marketingplatform/360/introducing-google-marketing-platform/**, accessed 8/21/2024.
[130] "Google to Acquire DoubleClick," Google Press Release, April 13, 2007.
[131] "This Deal Helped Turn Google Into an Ad Powerhouse. Is That a Problem?" *The New York Times*, September 21, 2020.
[132] "This Deal Helped Turn Google Into an Ad Powerhouse. Is That a Problem?" *The New York Times*, September 21, 2020.
[133] "This Deal Helped Turn Google Into an Ad Powerhouse. Is That a Problem?" *The New York Times*, September 21, 2020.

improve the company's relative position in the industry, including by funding acquisitions.[134] Professor Wiggins suggests that Google's "modest incremental profits" "likely did not enhance Google's ability to invest in employees and technology."[135] However, Professor Wiggins' contention that Google derived only "modest incremental profits" from its misconduct is based on his own flawed analysis of direct profits discussed elsewhere in this report. Moreover, as stated in the report of Professor Wiggins' fellow defendant expert Douglas Skinner, "Based on recent public disclosures, including its second quarter 2024 earnings results and call with investors, the Company has made and will continue to make substantial investments in AI infrastructure and capabilities," citing servers, network equipment, and data centers as particular areas of investment.[136] An overlooked consideration is how such long-term investments, made possible in part by the alleged DTPA misconduct, impacted the company's short-term profitability, and will continue to affect the company's profitability into the future.

68. Finally, the Wiggins Report questions the notion that any benefit to Google from RPO, DRS, and Project Bernanke could increase AdX win rates and revenue.[137] Professor Wiggins posits that "because of advertiser and publisher learning and experimentation the alleged deception was unlikely to impact auction outcomes."[138] However, his opinions vis-à-vis advertiser and publisher learning and experimentation amount to little more than speculation, and overlook the fact that Google has and continues to externalize the costs of its deception, shifting those costs to advertisers and publishers.

[134] Andrien Opening Report, ¶111.
[135] Wiggins Report, ¶263.
[136] Skinner Report, ¶69.
[137] Wiggins Report, ¶264.
[138] Wiggins Report, ¶266.

69. Evidence demonstrates the difficulty that competitors now face in trying to compete with Google's dominant display advertising position, which Google gained through its scheme to dominate the market, including through the DTPA misconducts. [redacted]

70. Thus, for all of the above reasons, the Wiggins Report misses the larger point, that the alleged DTPA misconducts alleged in this case are properly viewed as part of an *overall scheme* by Google to dominate and maintain its place in the display advertising industry using various levers at its disposal, *including the DTPA misconduct at issue*. Google's operating profit in display advertising does not even remotely represent the benefits to Google's positioning gained through its scheme, including the DTPA misconducts. The interconnectedness of Google's misconduct necessitates a holistic analysis accounting for the indirect benefits of the behavior, as I have

139 [redacted]

140 [redacted]

141 [redacted]

undertaken, to determine reasonable and appropriate deceptive trade practices civil penalties, sufficient to deter future misconduct.

c. Google's Revenue is a Relevant Measure to Consider in Determining Appropriate Civil Penalties

71. The Wiggins Report argues that I wrongly base my estimation of civil penalties on display advertising revenue rather than incremental profit. As I discuss at length above, while profit is useful to consider, in order to meet the burden of deterrence and considering the indirect and future benefit that Google derives from its conduct, the profit of Google's display advertising segment is wholly insufficient in isolation to determine the appropriate level of penalties. Here, and in my Opening Report, I consider the revenue and profit of Google's display advertising segment, as well as the revenue and profit of Google as a whole in forming my opinions.

72. In addition to arguing that display advertising revenue is the wrong measure to consider, the Wiggins Report also criticizes my calculation of Google's display advertising revenue. Professor Wiggins argues that my inclusion of revenue from AdMob, AdSense for Content, and Campaign Manager, as well as DV360 revenue from third party exchanges, is inappropriate.[142] I disagree.

73. As a preliminary matter, in its First Amended Responses and Objections to Plaintiffs' Third Set of Interrogatories, Google itself states, "[f]or the avoidance of doubt, Google will construe the term 'Ad Tech Products' to include the following Google products: Google Ads (solely as used for the purchase of display advertising, not search ad inventory), Display & Video 360, Campaign Manager, AdSense for Content (but not, for the avoidance of doubt, AdSense for Search), AdMob, and Google Ad Manager."[143] Google's internal documents also list the products

[142] Wiggins Report, ¶112.
[143] Defendant Google LLC's First Amended Responses and Objections to Plaintiffs' Third Set of Interrogatories, May 24, 2024, p. 4.

that fall under Google's core display business – this list includes AdMob, AdSense for Content, and Campaign Manager.[144] One of Google's internal documents explains that the [redacted] For example, Campaign Manager is an ad management tool for advertisers that "includes integrations with other Google products."[146] Google documents show that Campaign Manager users also use DV360 as a demand side platform, and that "[s]ome of that [Campaign Manager] money might then use DoubleClick Bid Manager (DBM) [now part of DV360] to purchase inventory via Ad Exchange (AdX) to buy an ad slot managed by DoubleClick for Publishers (in which case it can be purchased via Ad Exchange or by another Network/SSP)."[147] The same document also shows that DV360 is a demand source for AdX, AdMob, and AdSense for Content.[148] Thus, Google's entire suite of display advertising products work together and are leveraged as part of a larger strategy to dominate across the ad tech stack. While I only count violations based on the number of Open Auction transactions in the AdX data, when evaluating the benefits to Google of its deceptive behavior, I consider not just the incremental profit of the specific auction programs implemented by Google, but on the larger benefit Google gained from its display advertising business, and further, the role that their dominance in display advertising played in their success overall.

[144] GOOG-AT-MDL-002189396 at -400.
[145] GOOG-AT-MDL-001057220 at -247-248.
[146] "Introducing Campaign Manager 360," Google Blog, available at **https://support.google.com/campaignmanager/answer/10157783?hl=en**, accessed 8/22/2024.
[147] GOOG-AT-MDL-001057220 at -248, -250.
[148] GOOG-AT-MDL-001057220 at -250. *See also* GOOG-NE-02633839 at -844, a Google presentation from March 2017 showing that "AdX Buyers" contributed to AdMob's revenue in Q1 2017 and that AdX's contribution to AdMob revenue increased year over year.

74. [redacted]

D. The Wiggins Report's Claims that Google's History of Prior Violations Discussed in my Opening Report is Dissimilar to the Conduct at Issue Here is Incorrect

75. The Wiggins Report claims that "none of [the] examples [of Google's history of past fines and settlements discussed in my Opening Report] involved allegations similar to the alleged deception asserted in this case."[154] I disagree. Professor Wiggins reaches his conclusion

[149] GOOG-NE-07249237 at -237.
[150] GOOG-NE-03730264 at -265.
[151] GOOG-DOJ-15971437 at -454.
[152] GOOG-NE-13236353 at -379.
[153] GOOG-DOJ-AT-02218994 at -996. [redacted]
[154] Wiggins Report, ¶20.

by proposing several reasons that purportedly undermine the relevance of the [redacted] fines and settlements paid by Google between 2013 and 2023.[155] However, none of these reasons undermine the relevance of these fines and settlements, which establish that Google has a history of: (i) deceiving its customers (consumers and businesses) and regulators;[156] and (ii) engaging in anticompetitive practices.[157] As I discuss below, Professor Wiggins' assertions are

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155 Wiggins Report, ¶273 and [redacted]

156 [redacted]; "Google Will Pay $22.5 Million to Settle FTC Charges it Misrepresented Privacy Assurances to Users of Apple's Safari Internet Browser," FTC, August 9, 2012, available at https://www.ftc.gov/news-events/news/press-releases/2012/08/google-will-pay-225-million-settle-ftc-charges-it-misrepresented-privacy-assurances-users-apples, accessed 8/20/24; "Google to Pay $17 Million to Settle Privacy Case," The New York Times, November 18, 2013, available at https://www.nytimes.com/2013/11/19/technology/google-to-pay-17-million-to-settle-privacy-case.html, accessed 8/20/2024; "Google and YouTube Will Pay Record $170 Million for Alleged Violations of Children's Privacy Law," FTC, September 4, 2019, available at https://www.ftc.gov/news-events/news/press-releases/2019/09/google-youtube-will-pay-record-170-million-alleged-violations-childrens-privacy-law, accessed 8/20/2024; "Google pays nearly $392 million to settle sweeping location-tracking case," NPR, November 14, 2022, available at https://www.npr.org/2022/11/14/1136521305/google-settlement-location-tracking-data-privacy, accessed 8/20/2024; "Arizona announces $85M settlement with Google over user data," Associated Press, October 4, 2022, available at https://apnews.com/article/technology-business-lawsuits-arizona-440a27f1e7c2c672d3ccc727439978b4#, accessed 8/20/2024; "Attorney General Todd Rokita secures $20 million settlement with Google under same Indiana law being used against TikTok," Office of the Indiana Attorney General, December 29, 2022, available at https://events.in.gov/event/attorney_general_todd_rokita_secures_20_million_settlement_with_google_under_same_indiana_law_being_used_against_tiktok, accessed 8/20/2024; "AG Racine Announces Google Must Pay $9.5 Million for Using 'Dark Patterns' and Deceptive Location Tracking Practices that Invade Users' Privacy," Office of the Attorney General for the District of Colombia, December 30, 2022, available at https://oag.dc.gov/release/ag-racine-announces-google-must-pay-95-million, accessed 8/20/2024; "Google LLC to pay $60 million for misleading representations," Australian Competition & Consumer Commission, August 12, 2022, available at https://www.accc.gov.au/media-release/google-llc-to-pay-60-million-for-misleading-representations, accessed 8/20/2024.

157 [redacted]; "Google Settles Russian Antitrust Case on Android Phones," Bloomberg, April 17, 2017, available at https://www.bloomberg.com/news/articles/2017-04-17/google-settles-russian-antitrust-case-on-android-phones, accessed 8/21/2024; "Google Fined – This Time by the Turkish Competition Watchdog," Kluwer Competition Law Blog, November 5, 2018, available at https://competitionlawblog.kluwercompetitionlaw.com/2018/11/05/google-fined-this-time-by-the-turkish-competition-watchdog/, accessed 8/21/2024; "S. Korea fines Google $177 mln for blocking Android customization," Reuters, September 14, 2021, available at https://www.reuters.com/technology/skorean-antitrust-agency-fines-google-177-mln-abusing-market-dominance-2021-09-14/, accessed 8/21/2024; "Google loses appeal over EU antitrust ruling, but fine cut to $4.12 billion ," CNBC, September 14, 2022, available at https://www.cnbc.com/2022/09/14/eu-court-backs-antitrust-ruling-against-google-but-reduces-fine.html, accessed 8/21/2024; "Google fined $162 mln by India antitrust watchdog for abuse of Android platform," Reuters, October 20, 2022, available at https://www.reuters.com/world/india/india-competition-regulator-fines-google-16195-mln-anti-competitive-practices-2022-10-20/, accessed 8/21/2024; "Antitrust: Commission fines Google €2.42 billion for abusing dominance as search engine by giving illegal advantage to own comparison shopping service – Factsheet," European Commission, June 27, 2017, available at https://ec.europa.eu/commission/presscorner/detail/en/MEMO_17_1785, accessed 8/21/2024; "Competition

based on misleading classification of the conduct at issue in those proceedings, as well as certain unsupported and illogical assertions.

76. First, the Wiggins Report attempts to undermine the information as being compiled by a disgruntled competitor. This is nothing but a red herring. Professor Wiggins is correct that this information was not compiled by the FTC itself but was instead compiled by a third-party and filed with the FTC. However, Professor Wiggins does not dispute the contents. In other words, regardless of who prepared the list, Professor Wiggins does not challenge the salient fact shown by the list that Google has, in fact, been subject to the allegations of each respective case/proceeding and has paid those fines and settlements.

77. Fundamental to his conclusion, however, is an analysis purporting to classify the various fines and settlements based on the type of misconduct at issue in those proceedings.[158] Based on this analysis, Professor Wiggins concludes that none of the fines and settlements involved "claims similar to the deceptive conduct alleged in this case," but rather, were related to "Other claims (e.g. privacy, antitrust)."[159] Professor Wiggins classification of certain fines and settlements as privacy related is misleading.[160] Contrary to Professor Wiggins' assertions, the settlements he classifies as privacy related include settlements for alleged deceptive conduct that

Commission of India fines Google for abusing dominant position," Reuters, February 8, 2018, available at https://www.reuters.com/article/india-google-antitrust-idINKBN1FS29Z/, accessed 8/21/2024; "Turkey fines Google for abusing dominant position," Reuters, April 14, 2021, available at https://www.reuters.com/technology/turkey-fines-google-abusing-dominant-position-2021-04-14/, accessed 8/21/2024; "Antitrust: Commission fines Google €1.49 billion for abusive practices in online advertising," European Commission, March 20, 2019, available at https://ec.europa.eu/commission/presscorner/detail/en/IP_19_1770, accessed 8/21/2024; "The Autorité de la concurrence hands out a €220 millions fine to Google for favouring its own services in the online advertising sector," Autorité de la concurrence, June 7, 2021, available at https://www.autoritedelaconcurrence.fr/en/communiques-de-presse/autorite-de-la-concurrence-hands-out-eu220-millions-fine-google-favouring-its, accessed 8/21/2024; "India orders Google to allow third-party payments, slaps on another fine," Reuters, October 26, 2022, available at https://www.reuters.com/technology/india-fines-google-113-million-second-antitrust-penalty-this-month-2022-10-25/, accessed 8/20/2024.

[158] Wiggins Report, ¶273; Table 6.

[159] Wiggins Report, ¶273; Table 6.

[160] Wiggins Report, ¶276.

violate deceptive trade practices statutes of various jurisdictions. Perhaps the most egregious such example involves Google's $391 million settlement with 40 states led by the Commonwealth of Pennsylvania (the "Pennsylvania Location Litigation"), involving location tracking.[161] The allegations in the Pennsylvania Location Litigation involved Google's misrepresentations about location history, web and app activity, users' ability to control their privacy through Google account settings, and the personalization setting.[162] In other words, the Plaintiffs alleged Google deceived users about the information that it was collecting and the control that they had over Google's ability to collect that data and how it was used in advertising. Thirteen of the seventeen Plaintiff States in this litigation were also Plaintiffs in the Pennsylvania Location Litigation.[163] These states alleged that Google's deceptive conduct in the Pennsylvania Location Litigation violated *exactly the same* statutes as its deceptive conduct in this case.[164] The remaining Plaintiffs in the Pennsylvania Location Litigation that are not party to this lawsuit also alleged violations of their deceptive trade practice statutes. **Table 1** below reports the statutes which Plaintiff States in this matter that were also Plaintiffs in the Pennsylvania Location Litigation alleged Google violated in both cases.

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[161] "Assurance of Voluntary Compliance in the Matter of Commonwealth of Pennsylvania v. Google, LLC," November 10, 2022, available at https://www.attorneygeneral.gov/wp-content/uploads/2022/11/2022-11-14-PA-v.-Google-LLC-AVC-efile.pdf.

[162] "Assurance of Voluntary Compliance in the Matter of Commonwealth of Pennsylvania v. Google, LLC," November 10, 2022, available at https://www.attorneygeneral.gov/wp-content/uploads/2022/11/2022-11-14-PA-v.-Google-LLC-AVC-efile.pdf.

[163] These states are Alaska, Arkansas, Florida, Idaho, Kentucky, Louisiana, Mississippi, Missouri, Nevada, North Dakota, South Carolina, South Dakota and Utah. *See*, "Assurance of Voluntary Compliance in the Matter of Commonwealth of Pennsylvania v. Google, LLC," November 10, 2022, available at https://www.attorneygeneral.gov/wp-content/uploads/2022/11/2022-11-14-PA-v.-Google-LLC-AVC-efile.pdf.

[164] Certain states may have alleged violations for additional statutes to those at issue in this litigation. For example, Arkansas alleged violations of its the Personal Information Protection Act in addition to the Arkansas Deceptive Trade Practices Act.

TABLE 1

State Statutes Sued Under

State/Territory	Statute(s) Sued Under in this Matter	Statute(s) Sued Under in the Pennsylvania Location Litigation
Alaska	Alaska Unfair Trade Practices and Consumer Protection Act	Alaska Unfair Trade Practices and Consumer Protection Act
Arkansas	Arkansas Deceptive Trade Practices Act	Arkansas Deceptive Trade Practices Act; **Personal Information Protection Act**
Florida	Florida Deceptive and Unfair Trade Practices Act	Florida Deceptive and Unfair Trade Practices Act
Idaho	Idaho Consumer Protection Act; **Idaho Rules of Consumer Protection**	Idaho Consumer Protection Act
Kentucky	Kentucky Revised Statutes ("KRS") Chapter 367	Kentucky Revised Statutes ("KRS") Chapter 367
Louisiana	Louisiana Unfair Trade Practices and Consumer Protection Law	Louisiana Unfair Trade Practices and Consumer Protection Law
Mississippi	Mississippi Consumer Protection Act	Mississippi Consumer Protection Act
Missouri	Missouri's Merchandising Practices Act; **15 Missouri Code of State Regulations 60-8 and 60-9**	Missouri's Merchandising Practices Act
Nevada	Nevada Deceptive Trade Practices Act	Nevada Deceptive Trade Practices Act
North Dakota	North Dakota Century Code ("N.D.C.C.") § 51-15-01, et seq.	North Dakota Century Code ("N.D.C.C.") § 51-15-01, et seq.
South Carolina	South Carolina Unfair Trade Practices Act	South Carolina Unfair Trade Practices Act
South Dakota	South Dakota's Codified Laws Chapter 37-24	South Dakota's Codified Laws Chapter 37-24
Utah	Utah Consumer Sales Practices Act	Utah Consumer Sales Practices Act

Notes:
1) Only states who were plaintiffs in both this matter and the Pennsylvania Location Litigation are listed here.
2) Statutes that were sued under in one case but not the other are bolded. Antitrust statutes charged under in this litigation are not listed.
Sources: Fourth Amended Complaint in State of Texas et al. vs. Google LLC, In Re: Google Digital Advertising Antitrust Litigation, Civil Action No. 1:21-cv-06841-PKC, May 5, 2023; Assurance of Voluntary Compliance in the Commonwealth of Pennsylvania vs. Google LLC, November 10, 2022.

78. Additionally, I understand that an assessment of an offender's history of prior violations should focus on the conduct at issue and not necessarily be limited to a particular statute or jurisdiction.[165] I understand that the "the history of prior violations" factor is not limited to violations within a particular geography, and Professor Wiggins' conclusory statements to the contrary are wholly unsupported in his report. For example, conspicuously absent from the "history of previous violations" factor in both Texas' and Utah's statutes is any indication of geographical

[165] Further, I find that it would be illogical to exclude violations outside of a certain jurisdiction when the nature of the conduct is not jurisdictional, for example I understand all states have a variation of deceptive trade practice law.

location or identical misconduct.[166] The history of alleged misbehavior on the part of the offender is relevant as it presents a pattern for the trier of fact to consider in making its determination of penalties. Additionally, repeated offenses indicate the prior assessed penalty amounts were insufficient to deter future misconduct, and that more severe penalties are warranted.

79. Similarly, limiting an assessment of the history of prior violations to a particular statute may preclude relevant information from being considered. I understand that many states have multiple consumer protection statutes addressing various aspects of consumer rights and protections. Some such laws may offer broad protections like the deceptive trade practices acts at issue in this litigation, while others, like the Arkansas Personal Information Protection Act ("APIPA") or the Texas Capture or Use of Biometric Identifier Act ("CUBI"), may offer more focused protections. Moreover, I understand that various states' consumer protection statutes allow a private right of action by private parties, a government enforcement action, or both, to seek remedies or enforcement for violation of the statutes. If the inquiry into past violations is limited to a particular statute, relevant information regarding similar conduct by an offender may be inappropriately omitted from consideration.

80. For the same reason, the fact that some of the fines and settlements were related to jurisdictions outside the United States (even if there may be differences between statutes applicable domestically)[167] is irrelevant to my analysis of determining whether Google has a history of engaging in deceptive and anticompetitive conduct. Moreover, Google is a global company, and there is no contrary evidence to justify an assumption that Google is willing to significantly modify its conduct between jurisdictions—both foreign and domestic. The Wiggins Report does not

[166] I also understand that, in assessing civil penalties in other contexts where the history of previous violations is a statutory factor, various courts have noted that the history of previous violations should be considered generally.
[167] There may even be differences between domestic statutes of different jurisdictions.

provide any reason to think that this would be the case, nor does he argue that the underlying Google deceptive conduct somehow automatically stopped once one crossed the U.S. border. On the contrary, Google's history of past fines and settlements indicates that its misconduct abroad also takes place in the United States and vice versa. For example, in 2012, Google paid $22.5 million to settle charges brought by the FTC and in 2013, an additional $17 million to 37 States and Washington D.C. for falsely claiming that it would *not* use tracking cookies on certain users.[168] In 2020, France fined Google 100 million euros over Google's cookie practices, and again in 2022, fined Google 150 million euros for making it difficult to refuse the use of cookies.[169] In yet another example, Google was forced to pay or settled with various U.S. States and Australia over allegations it misrepresented to some consumers that it was not tracking their device's location.[170] These examples show that Google engages in similar deceptive misconduct all over the world, and that previous fines and settlements have not dissuaded Google from such misconduct.

81. Such behavior also extends to Google's anticompetitive conduct. In October 2022, Google was fined $113 million by India's antitrust body for restricting app developers from using non-Google payment services.[171] Less than 14 months later, a United States federal jury unanimously found that Google had similarly maintained a monopoly and engaged in similar

[168] "Google Will Pay $22.5 Million to Settle FTC Charges it Misrepresented Privacy Assurances to Users of Apple's Safari Internet Browser," FTC, August 9, 2012, available at https://www.ftc.gov/news-events/news/press-releases/2012/08/google-will-pay-225-million-settle-ftc-charges-it-misrepresented-privacy-assurances-users-apples, accessed 8/20/24; "Google to Pay $17 Million to Settle Privacy Case," The New York Times, November 18, 2013, available at https://www.nytimes.com/2013/11/19/technology/google-to-pay-17-million-to-settle-privacy-case.html, accessed 8/20/2024.

[169] "France fines Google and Facebook over cookies," BBC, January 7, 2022, available at https://www.bbc.com/news/technology-59909647, accessed 8/20/2024.

[170] "Google pays nearly $392 million to settle sweeping location-tracking case," NPR, November 14, 2022, available at https://www.npr.org/2022/11/14/1136521305/google-settlement-location-tracking-data-privacy, accessed 8/20/2024; and "Google LLC to pay $60 million for misleading representations," Australian Competition & Consumer Commission, August 12, 2022, available at https://www.accc.gov.au/media-release/google-llc-to-pay-60-million-for-misleading-representations, accessed 8/20/2024

[171] "India orders Google to allow third-party payments, slaps on another fine," Reuters, October 26, 2022, available at https://www.reuters.com/technology/india-fines-google-113-million-second-antitrust-penalty-this-month-2022-10-25/, accessed 8/20/2024.

anticompetitive conduct in the United States.[172] Similarly, Google was fined in Russia, the EU, India, and Turkey for using its Android mobile platform to ensure all Android phones had Google set as the default search engine.[173] On August 5, 2024, a federal judge in the United States ruled that "Google is a monopolist, and it has acted as one to maintain its monopoly" in the general search services and general search text ads markets.[174] These antitrust cases are indicative of Google's anticompetitive practices are not isolated incidents but a pattern repeated across multiple countries.

82. The conduct at issue here is Google's practice of deceiving and/or misleading its customers. Professor Wiggins' classification and dismissal of settlements as privacy related is merely an attempt to undermine the similarity of Google's misconduct based on the subject matter of the deception, rather than the deception itself. Using Professor Wiggins' logic, because the subject matter of Google's deception in this case, namely, auction manipulation in the AdTech stack is different from deceiving users and violating their privacy, fines and settlements related to what he classifies as privacy violations should *not* be considered when determining whether

[172] "Google Loses Antitrust Court Battle With Makers of Fortnite Video Games," The New York Times, December 11, 2023, available at https://www.nytimes.com/2023/12/11/technology/epic-games-google-antitrust-ruling.html, accessed 8/20/2024. Later, Google agreed to pay $700 million to settle a similar case against all 50 States. *See,* "Google, US states defend $700 mln Play store antitrust settlement," Reuters, April 18, 2024, available at https://www.reuters.com/legal/transactional/google-us-states-defend-700-mln-play-store-antitrust-settlement-2024-04-18/, accessed 8/21/2024.
[173] *See,* "Google Settles Russian Antitrust Case on Android Phones," Bloomberg, April 17, 2017, available at https://www.bloomberg.com/news/articles/2017-04-17/google-settles-russian-antitrust-case-on-android-phones, accessed 8/21/2024; "Google Fined – This Time by the Turkish Competition Watchdog," Kluwer Competition Law Blog, November 5, 2018, available at https://competitionlawblog.kluwercompetitionlaw.com/2018/11/05/google-fined-this-time-by-the-turkish-competition-watchdog/, accessed 8/21/2024; "Google loses appeal over EU antitrust ruling, but fine cut to $4.12 billion," CNBC, September 14, 2022, available at https://www.cnbc.com/2022/09/14/eu-court-backs-antitrust-ruling-against-google-but-reduces-fine.html; accessed 8/21/2024, and "Google fined $162 mln by India antitrust watchdog for abuse of Android platform," Reuters, October 20, 2022, available at https://www.reuters.com/world/india/india-competition-regulator-fines-google-16195-mln-anti-competitive-practices-2022-10-20/, accessed 8/21/2024.
[174] United States District Court for the District of Columbia, *United States v. Google LLC*, Case No. 20-cv-3010 (APM), Memorandum Opinion, August 5, 2024, p. 8.

Google has a history of violations related to deceiving and misleading business practices.[175] That's like arguing that your child does not have a history of lying because the first time he got caught, he was lying about his grades, but on the latest occasion, he was lying about attending a party. This is improper and illogical.

83. Over 90% of the fines and settlement fees that Professor Wiggins classifies as "privacy" related involve allegations of Google deceiving users (or not informing them at all) about the information that it was collecting and the control that they had over Google's ability to collect that data.[176] Several fines and settlements that Professor Wiggins attempts to dismiss as

[175] For example, Professor Wiggins' Appendix G "lists a $391.5 million dollar settlement for privacy violations on November 14, 2022. This refers to Google's settlement for tracking user location. *See,* "Attorney General Josh Shapiro Announces $391 Million Settlement with Google Over Location Tracking Practices," Office of the Pennsylvania Attorney General, November 14, 2022, available at https://www.attorneygeneral.gov/taking-action/attorney-general-josh-shapiro-announces-391-million-settlement-with-google-over-location-tracking-practices/, accessed 8/22/2024. While the allegations of that case centered around deceiving consumers about tracking their location, Professor Wiggins somehow does not consider this deception in Google's advertising stack to be similar conduct to the "deceptive conduct alleged in this case."

[176] Wiggins Report Table G1; "Italy slaps Google's hand with $1.4M fine for not clearly labeling Street View cars," VentureBeat, April 4, 2014, available at https://venturebeat.com/business/italy-slaps-googles-hand-with-1-4m-fine-for-not-labeling-street-view-cars/, accessed 8/28/2024; "Italy's antitrust regulator fines Google, Apple over data use," Reuters, November 29, 2021, available at https://www.reuters.com/technology/italys-antitrust-fines-google-apple-commercial-use-data-2021-11-26/, accessed 8/28/2024; "Google LLC to pay $60 million for misleading representations," Australian Competition & Consumer Commission, August 12, 2022, available at https://www.accc.gov.au/media-release/google-llc-to-pay-60-million-for-misleading-representations, accessed 8/28/2024; "S. Korea fines Google, Meta billions of won for privacy violations," Reuters, September 15, 2022, available at https://www.reuters.com/technology/skorea-fines-google-meta-over-accusations-privacy-law-violations-yonhap-2022-09-14/, accessed 8/28/2024; "Google Will Pay $22.5 Million to Settle FTC Charges it Misrepresented Privacy Assurances to Users of Apple's Safari Internet Browser," FTC, August 9, 2012, available at https://www.ftc.gov/news-events/news/press-releases/2012/08/google-will-pay-225-million-settle-ftc-charges-it-misrepresented-privacy-assurances-users-apples, accessed 8/28/2024; "Google to pay $7 million in multistate settlement over Street View," Washington State Office of the Attorney General, March 11, 2013, available at https://www.atg.wa.gov/news/news-releases/google-pay-7-million-multistate-settlement-over-street-view, accessed 8/28/2024; "Google to Pay $17 Million to Settle Privacy Case," The New York Times, November 18, 2013, available at https://www.nytimes.com/2013/11/19/technology/google-to-pay-17-million-to-settle-privacy-case.html, accessed 8/28/2024; "Google and YouTube Will Pay record $170 Million for Alleged Violations of Children's Privacy Law," FTC, September 4, 2019, available at https://www.ftc.gov/news-events/news/press-releases/2019/09/google-youtube-will-pay-record-170-million-alleged-violations-childrens-privacy-law, accessed 8/28/2024; Global Settlement Agreement in the case of Balderas v. Tiny Lab Productions, et al.; No. 1:18-cv-00854-MV-JFR and Balderas v. Google LLC, No. 1:20-cv-00143-NF-KHR; "Attorney General Mark Brnovich Achieves Historic $85 Million Settlement with Google," Arizona Office of the Attorney General, October 4, 2022, available at https://www.azag.gov/press-release/attorney-general-mark-brnovich-achieves-historic-85-million-settlement-google, accessed 8/28/2024; "Google pays nearly $392 million to settle sweeping location-tracking case," NPR, November 14, 2022, available at https://www.npr.org/2022/11/14/1136521305/google-settlement-location-tracking-data-

dissimilar are related to alleged violations of state or federal deceptive trade practice statutes that are the same as those asserted in this case, or the equivalent versions of different jurisdictions.[177]

84. The Wiggins Report also claims that considering these settlements and fines are inconsistent with the framework I used in my Opening Report, which he fundamentally mischaracterizes as being limited to "eliminat[ing] Google's financial incentive to engage in the misconduct." But that's wrong. This false characterization alone invalidates this critique. As detailed above and in my Opening Report, my holistic framework explicitly considers Google's history of previous similar violations as a factor in assessing the appropriate amount of civil penalties. Additionally, as detailed in my Opening Report, "both the alleged deceptive trade practices misconduct and the separate antirust conduct alleged in this case play a role within an overall scheme to dominate the display advertising industry."[178] As such, both conducts are at issue

privacy, accessed 8/28/2024; "FTC, States Sue Google and iHeartMedia for Deceptive Ads Promoting the Pixel 4 Smartphone," FTC, November 28, 2022, available at https://www.ftc.gov/news-events/news/press-releases/2022/11/ftc-states-sue-google-iheartmedia-deceptive-ads-promoting-pixel-4-smartphone, accessed 8/28/2024; "Google to pay $29.5 million to settle DC, Indiana lawsuits over location tracking," The Hill, December 31, 2022, available at https://thehill.com/policy/technology/3794301-google-to-pay-29-5-million-to-settle-dc-indiana-lawsuits-over-location-tracking/, accessed 8/28/2024; "Google to pay Indiana $20 million to resolve tracking privacy lawsuit," PBS News, December 30, 2022, available at https://www.pbs.org/newshour/economy/google-to-pay-indiana-20-million-to-resolve-tracking-privacy-lawsuit, accessed 8/28/2024; Complaint for Injunction, Civil Penalties, and Other Equitable Relief in the People of the State of California v. Google, September 14, 2023; Plaintiff's First Amended Petition in The State of Texas v. Google LLC, filed May 19, 2022.

[177] Draft of Assurance of Voluntary Compliance in the case of States v. Google, available at https://agportal-s3bucket.s3.amazonaws.com/uploadedfiles/WiFi%20-%20AVC%20-%20Final.pdf, accessed 8/28/2024; Assurance of Voluntary Compliance in the Matter of Google Inc., November 13, 2013; Complaint for Permanent Injunction, Civil Penalties, and Other Equitable Relief in the Matter of Federal Trade Commission and People of the State of New York v. Google LLC and YouTube LLC, Case No.: 1:19-cv-2642, September 4, 2019; Complaint for Injunctive and Other Relief in the Matter of State of Arizona v. *Google LLC*, Case No: CV 2020-006219, May 27, 2020; Assurance of Voluntary Compliance in the Matter of Commonwealth of Pennsylvania v. Google, LLC, November 10, 2022; Complaint in the Matter of Google LLC, and IHeartMedia, Inc., Docket Nos. C-4783 and C-4784, February 8, 2023; "Settlement Agreement in the Matter of the District of Columbia v. Google LLC," December 29, 2022; Settlement Agreement in *State of Indiana v. Google LLC*, Cause No. 49D01-2201-PL-002399, December 29, 2022; Plaintiff's First Amended Petition in the Matter of the State of Texas v. Google LLC, Cause No. 2201-88230-D, May 19, 2022.

[178] Andrien Opening Report, ¶11.

in this case, and Google's history of prior fines and settlements are also relevant to determining the penalties in this case.

85. Professor Wiggins also claims the settlements that he classifies as privacy related did not involve admissions of liability, and therefore "do not indicate that Google has engaged in any misconduct, much less a similar type of misconduct to what is at issue in this case."[179] While Google may have settled several proceedings without admitting liability, that does not make these settlements irrelevant for the purposes of determining the statutory penalties in this case. The concept of relative valuation based on observed transactions is well established in finance, is considered one of the three main approaches to valuation (the "Market Approach").[180] While finding observable transactions involving exactly the same asset or company is not possible, the "standard sought is usually one or reasonable and justifiable similarity," which is typically attainable.[181] Of course, adjustments to the observed transactions to make them more comparable to the subject asset may be necessary.[182] Courts regularly accept this methodology, and I too have submitted several expert reports that include the Market Approach.

86. The application of the Market Approach is not limited to valuation but has also been extended to damages calculations. For example, one factor that is considered in determining reasonable royalty damages in patent cases is "the royalties received by the patentee for the licensing of the patent in suit, proving or tending to prove an established royalty."[183] The Federal Circuit approves of reliance on prior patent licenses, which are often not granted in identical

[179] Wiggins Report, ¶275.
[180] Sheridan Titman & John D. Martin, Valuation: The Art and Science of Corporate Investment Decisions (Addison Wesley, 2007) p. 215; Shannon Pratt, Robert Reilly, Robert Schweihs, "Valuing A Business," Third Edition, Chapters 10 and 11.
[181] Shannon Pratt, Robert Reilly, Robert Schweihs, "Valuing A Business," Third Edition , p. 204.
[182] Sheridan Titman & John D. Martin, *Valuation: The Art and Science of Corporate Investment Decisions (*Addison Wesley, 2007), pp. 216 – 220.
[183] *Georgia-Pacific v. United States Plywood Corp*., 318 F. Supp. 1116, 1120-21 (S.D. N.Y. 1970), modified and aff'd, 446 F.2d 295 (2d Cir. 1971).

circumstances (including licenses granted as part of litigation settlements), as long as agreements are sufficiently comparable and reasonable adjustments for differences in contexts are made.[184] Like Google's "privacy" related settlements, patent litigation settlements often do not include admissions of liability, and are often entered into prior to determinations of validity and infringement. Accordingly, these settlements require an adjustment for a determination of liability to make them more appropriate for a damages determination. However, this is typically an upward adjustment, because, as the Supreme Court recognizes "[m]ost defendants are unlikely to settle unless the cost of the predicted judgment, discounted by its probability, plus the transaction costs of further litigation, are greater than the cost of the settlement package."[185]

87. While Professor Wiggins claims that "[t]hese settlements could just as easily be explained as efforts to avoid the costs and uncertainties of litigation and the associated distractions of executives who are more usefully employed in running Google's business," he provides no evidence to show that the costs associated with the litigation or executives being distracted were so great that Google would be willing to pay millions of dollars to avoid these costs. In one case, the settlement was valued at $5 billion.[186]

88. Finally, Professor Wiggins asserts that Google's past fines and settlements should be considered "detrimental" because "standard economic analysis recognizes that firms seek to maximize their profits" and each fine or settlement reduced Google's profits.[187] This is incorrect, or at the very least, an insufficient or limited goal that can lead to imprudent decisions. Professor Wiggins seems to be unaware of the fundamental goal of financial management, which is taught

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[184] *See, e.g. Prism Techs. LLC v. Sprint Spectrum L.P.*, 849 F.3d 1360, 1369–70 (Fed. Cir. 2017).
[185] *Evans v. Jeff D.*, 475 U.S. 717, 734, 106 S.Ct. 1531, 89 L.Ed.2d 747 (1986) ; *Staton v. Boeing Co.*, 327 F.3d 938, 964 (9th Cir. 2003) (quoting Evans , 475 U.S. at 734, 106 S.Ct. 1531)
[186] Wiggins Report, Table G1.
[187] Wiggins Report, ¶278.

to undergraduates at the McCombs School of Business at the University of Texas in chapter one of the first finance course that they are required to take. Specifically, the goal of financial management of a firm is to maximize shareholder value.[188] Profit maximation is considered an imprecise objective because it is unclear which profit is to be maximized – is it profit for the current year, or next year or over some five, ten year or longer-term period? For example, an aircraft manufacturer could choose to maximize its current profit by eliminating its quality control function and using defective parts in its airplanes (instead of replacing them with new parts). This would lower its costs and maximize its profit in the year this policy is implemented. In fact, it may even maximize profits for several years. But as we know, eventually an airplane likely will crash, with very significant and detrimental effects to the aircraft manufacturer and others. Such an imprudent action can be justified if the goal is to simply maximize profits. But it is not justifiable when the goal is to maximize shareholder value because the market would penalize the share price of the aircraft manufacturer for the increased risk associated with airplane crashes if it would implement such measures. As such, the relevant measure is shareholder value, not profit maximization. And as documented extensively in my Opening Report, Google has outperformed the market and grown to be the fourth largest company in the world. Thus, even Google's seemingly significant fines and settlements of over [redacted] have not hindered its financial performance. In fact, even if measured as a portion of Google's profits, this [redacted] is merely [redacted] of Google's net income between 2011 and 2022 and [redacted] of Google's revenue over the same period.[189].

[188] Fundamentals of Corporate Finance, pp. 12, 13.
[189] S&P Capital IQ; Alphabet Inc. Form 10-Ks for fiscal years ended 2011-2022.

E. The Wiggins Report Improperly Quantifies and Significantly Understates Violation Counts

89. Professor Wiggins claims that I have inflated violation counts and thus overestimated the number of DTPA violations committed by Google. Professor Wiggins makes several "corrections" to my violation count, which I address below and explain why each is unfounded.

a. Google Deceived and Misled Auction Participants into Believing That AdX Ran a Second-Price Auction

90. The Wiggins Report argues that it is incorrect to assume that all Open Auctions were affected by Google's actions during the period in which the misconducts were active.[190] In doing so, he critiques my reliance on Dr. Weinberg, an auction expert proffered by the Plaintiff States.[191]

91. I understand, however, that during the relevant period Google falsely, misleadingly, and deceptively misrepresented the entire AdX auction model, for example stating that "Ad Exchange uses a second price auction model,"[192] when in fact it did not, or by stating that all participants were on equal footing in AdX auctions,[193] when in fact they were not. Indeed, while Google deceived auction participants into believing that AdX auctions had certain characteristics that it did not, Google was actively manipulating AdX auctions through its RPO, DRS, and Bernanke programs such that the auction model was not second price and such that all players

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[190] *See, for example*, Wiggins Report, ¶¶15, 118.

[191] *See, for example*, Wiggins Report, ¶¶15, footnote 5; 118, footnote 263. I also understand that other experts besides Dr. Weinberg, including Dr. Chandler and Dr. Rudin, have reached the same conclusion.

[192] GOOG-NE-06567486 at -490.

[193] "Simplifying programmatic: first price auctions for Google Ad Manager," Google Blog, March 6, 2019, available at https://blog.google/products/admanager/simplifying-programmatic-first-price-auctions-google-ad-manager/, accessed 5/7/2024; "How Open Bidding Works," Google Ad Manager, November 20, 2019, available at https://web.archive.org/web/20191120001210/https:/support.google.com/admanager/answer/7128958, accessed 5/23/2024.

were not on equal footing.[194] As I state in my Opening Report, "[w]hile a specific Google program might not have run on each auction during a given period, the misrepresentations of those targeted auctions as second-price auctions, first-price auctions, or that participants were on equal footing in such auctions, and the inability of publishers and advertisers to determine whether and to what extent Google's programs/conduct applied to a given auction caused publishers and advertisers to behave differently than they would have but for Google's misconduct."[195] In other words, through its auction manipulation programs and its deception regarding those manipulations, Google affected all Open Auctions and all Open Auction participants.

92. I understand that Dr. Weinberg explained that Google's conducts individually and in totality were deceptive, which created a situation where Google's entire display advertising ecosystem was affected by Google's conduct[196] and that each auction was affected.[197]

93. First, Dr. Weinberg explained that Project Bernanke (all forms of it) was deceptive[198] because it required advertisers, if they were to make the optimal decision, to bid shade, which Dr. Weinberg noted in his opening report and which I understand Google did not dispute.[199] But Bernanke was also deceptive because it induced advertisers, through its auto-bidding functionality, to trust Google's GDN to optimize on their behalf (which it did not) and to submit truthful, non-optimal bids.[200] Advertisers only did this because Google chose not to disclose Buy-Side DRS, Project Bernanke, or Project Global Bernanke (with first-price payment rule), which means Google's decision not to disclose the conduct was also deceptive.[201]

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[194] Weinberg Report, §§ 7.A; 7.D; 7.F; 8.E; 8.G; 9.B.
[195] Andrien Opening Report, ¶98.
[196] Rebuttal Report of Professor Matthew Weinberg, September 9, 2024 ("Weinberg Rebuttal Report"), §IV. B; Interview with Dr. Matthew Weinberg, September 8, 2024.
[197] *See* Weinberg Rebuttal Report, §IV.G; Interview with Dr. Matthew Weinberg, September 8, 2024.
[198] Weinberg Rebuttal Report, §IV.C; Interview with Dr. Matthew Weinberg, September 8, 2024.
[199] Weinberg Rebuttal Report, §IV.C; Interview with Dr. Matthew Weinberg, September 8, 2024.
[200] Weinberg Rebuttal Report, §IV.C; Interview with Dr. Matthew Weinberg, September 8, 2024.
[201] Weinberg Rebuttal Report, §IV.C; Interview with Dr. Matthew Weinberg, September 8, 2024.

94. I also understand from Dr. Weinberg that Google acted deceptively regarding Project Bernanke because it misrepresented how GDN functioned.[202] Because of that deception, publishers did not (and likely could not) set optimal reserves, even if they were perfectly processing the winning bid date on all auctions.[203] Dr. Weinberg goes on to explain how the "collusion" aspect of Project Bernanke created additional deception that prevented publishers from acting optimally, which directly refutes Professor Wiggin's claim that publishers were perfectly optimizing reserves.[204]

95. In light of these actions, Dr. Weinberg found that Google's conduct with respect to Project Bernanke was deceptive towards advertisers during all periods when Buy-side DRS/Project Bernanke used a first-price rule and was deceptive towards publishers during all periods.[205]

96. Dr. Weinberg goes on to explain how DRS was also deceptive.[206] Dr. Weinberg found that the conduct was deceptive towards advertisers in regards to DRSv1, because Google's conduct would encourage advertisers/ad buying tools to bid their true values instead of bid-shading in the dynamic region,[207] and was deceptive as to DRSv2 because Google's deception caused advertisers to pay more than their value for impressions, because advertisers and ad buying tools believed AdX was running a second-price auction—what Google claimed—when it was not.[208] This led to suboptimal behavior.[209] And even when confronted, Google made minimal, deceptive disclosures and communications (both publicly and privately) that were not sufficient to inform ad

[202] Weinberg Rebuttal Report, §IV.C; Interview with Dr. Matthew Weinberg, September 8, 2024.
[203] Weinberg Rebuttal Report, §IV.C; Interview with Dr. Matthew Weinberg, September 8, 2024.
[204] Weinberg Rebuttal Report, §IV.C; Interview with Dr. Matthew Weinberg, September 8, 2024.
[205] Weinberg Rebuttal Report, §IV.C; Interview with Dr. Matthew Weinberg, September 8, 2024.
[206] Weinberg Rebuttal Report, §IV.D; Interview with Dr. Matthew Weinberg, September 8, 2024.
[207] Weinberg Rebuttal Report, §IV.D; Interview with Dr. Matthew Weinberg, September 8, 2024.
[208] Weinberg Rebuttal Report, §IV.D; Interview with Dr. Matthew Weinberg, September 8, 2024.
[209] Weinberg Rebuttal Report, §IV.D; Interview with Dr. Matthew Weinberg, September 8, 2024.

buying tools to act optimally.[210] This caused advertisers to pay more than their bid for impressions and publishers to set reserves too low and to believe that they were always being paid their price floors.[211]

97. Dr. Weinberg also explains how RPO was deceptive towards advertisers.[212] If advertisers fully understood RPO, they would have significantly shaded their bids.[213] Because they did not, they engaged in behavior that was suboptimal.[214] In explaining this, Dr. Weinberg addresses Professor Wiggins's contentions and shows how, even if those contentions are accurate, Google's concealment of RPO, by itself, was deceptive towards advertisers.[215] But that concealment was not all that Google did; Google explicitly suggested that bidders continue to act in a now-suboptimal way after announcing RPO.[216] Combined with Google's attempts to conceal RPO, this created deception for the duration of RPO's existence.[217]

98. Taken together, Dr. Weinberg explains that these and other acts affected the entirety of Google's display advertising ecosystem.[218] This deception arose because of the lack of disclosure, the deceptive misrepresentations about the conducts, the deceptive mechanics that were used across conducts, and the conduct-specific acts and results, like the fact that the entire DRSv2 program generated no additional revenue for Google unless they deceived some advertisers into bidding in the dynamic region (a suboptimal behavior), and that RPO ran a significant risk of

[210] Weinberg Rebuttal Report, §IV.D; Interview with Dr. Matthew Weinberg, September 8, 2024.
[211] Weinberg Rebuttal Report, §IV.D; Interview with Dr. Matthew Weinberg, September 8, 2024.
[212] Weinberg Rebuttal Report, §IV.E; Interview with Dr. Matthew Weinberg, September 8, 2024.
[213] Weinberg Rebuttal Report, §IV.E; Interview with Dr. Matthew Weinberg, September 8, 2024.
[214] Weinberg Rebuttal Report, §IV.E; Interview with Dr. Matthew Weinberg, September 8, 2024.
[215] Weinberg Rebuttal Report, §IV.E; Interview with Dr. Matthew Weinberg, September 8, 2024.
[216] Weinberg Rebuttal Report, §IV.E; Interview with Dr. Matthew Weinberg, September 8, 2024.
[217] Weinberg Rebuttal Report, §IV.E; *see also* ¶82; Interview with Dr. Matthew Weinberg, September 8, 2024.
[218] *See* Weinberg Rebuttal Report, §IV.B, §IV.G; Interview with Dr. Matthew Weinberg, September 8, 2024.

inducing hyper-aggressive bid-shading unless Google deceived some advertisers to ignore the impact of their current bids on future reserves.[219]

99. Dr. Weinberg finds that in many cases Google took these actions with intent to deceive.[220]

100. Dr. Weinberg explains that these deceptions allowed Google to recruit participants to its ecosystem with the allure of simplicity.[221]

101. Because of all this, Dr. Weinberg found that Google's deceptive behavior is pervasive and systemic, that it is not limited to the deceptive conducts, and that Google deceived participants to join its display advertising ecosystem in the first place by marketing simplicity.[222]

102. I also understand that Dr. Weinberg explained that Google's deceptive ecosystem influenced all auctions during the relevant period.[223] This is based on his view that some participants would not even be in Google's ecosystem (even if they were not directly affected by a conduct) but for Google's deceptions.[224]

103. Additionally, I understand that Dr. Weinberg specifically addresses Google's claim that it was running a truthful second-price auction.[225] Dr. Weinberg explains that, even though Google claimed to run a truthful second-price auction until 2019, due to Project Bernanke, DRSv1/v2, and RPO, it was actually not optimal for advertisers to truthfully bid their values.[226] Because it was not optimal to bid truthfully, Google was acting deceptively and not running a truthful second-price auction.[227] Dr. Weinberg opines that this deception touched all parts of

[219] Weinberg Rebuttal Report, §IV; Interview with Dr. Matthew Weinberg, September 8, 2024.
[220] Weinberg Rebuttal Report, §IV.B; Interview with Dr. Matthew Weinberg, September 8, 2024.
[221] Weinberg Rebuttal Report, §IV.B; Interview with Dr. Matthew Weinberg, September 8, 2024.
[222] Weinberg Rebuttal Report, §IV.B; Interview with Dr. Matthew Weinberg, September 8, 2024.
[223] *See* Weinberg Rebuttal Report, §IV.G; Interview with Dr. Matthew Weinberg, September 8, 2024.
[224] Weinberg Rebuttal Report, §IV.G; Interview with Dr. Matthew Weinberg, September 8, 2024.
[225] Weinberg Rebuttal Report, §IV.B; Interview with Dr. Matthew Weinberg, September 8, 2024.
[226] Weinberg Rebuttal Report, §IV.B; Interview with Dr. Matthew Weinberg, September 8, 2024.
[227] *See* Weinberg Rebuttal Report, §IV.B; Interview with Dr. Matthew Weinberg, September 8, 2024.

Google's display advertising ecosystem, including even advertisers' decision to join the ecosystem in the first place.[228]

b. A Query's Origination Location is Not the Only Relevant Geographic Metric

104. Professor Wiggins argues that I should have limited my DTPA violation count to those Open Auction transactions involving U.S. users [redacted].[229] First of all, according to Google's own description of the AdX data produced, the AdX submission represents [redacted] The individual who initiates a query (also called an ad request) by visiting a website is not the only participant in the AdX auction process, but rather acts as the catalyst for an auction to begin.[232] The publisher entities who sell, and advertiser entities who buy display advertising space, as well as intermediaries they may retain to help them with the process are direct participants in the auction, and have been deceived or misled by Google's misconducts. To ignore these direct participants' geography, as Professor Wiggins has done, is improper and untethered to the facts of this case.

105. Indeed, the location of *all* participants in AdX Open Auctions is relevant. If a user outside of the United States initiates a query, but either the advertiser or publisher entity (or their representatives) – all parties to the transaction – sit in the United States, that transaction should

[228] Weinberg Rebuttal Report, §IV.B; §IV.G; Interview with Dr. Matthew Weinberg, September 8, 2024.
[229] Wiggins Report, §IV.A.
[230] Letter from David Pearl to Mark C. Mao and Walter Noss, Re: In re: Google Digital Advertising Antitrust Litigation, No. 1:21-md-03010 (PKC), May 30, 2023.
[231] Letter from David Pearl to Walter Noss, September 29, 2023, Appendix A.
[232] The AdTech Book describes the real time bidding process, listing as the first step that "a user visits a page (example.com)" and the second step as "the page contains ad slot with JavaScript code that requests content from the first-party ad server, known as an ad request." *See* The AdTech Book (Clearcode Services S.A., 2023), Chapter 9.

count as a violation. Dr. Michael Baye, an expert for Google, acknowledges that all three parties are relevant, saying "Indirect network effects are important in this case because the alleged conduct centers on Google's role as a multi-sided platform that matches *advertisers* with *publisher* impressions displayed to *internet users*."[233] Google itself acknowledges the importance of multiple parties to its display advertising business, as shown below in **Figure 3**, a screen shot from an internal document.[234]

FIGURE 3

106. The AdX auction data produced by Google, however, [redacted]

[233] Expert Report of Michael R. Baye, August 6, 2024, ¶43 (emphasis added).
[234] GOOG-AT-MDL-002178277 at -277.
[redacted]

[redacted]

107. [redacted]

108. I stand by my count of AdX Open Auction transactions "involving U.S. users" as represented by Google, without limiting, as Professor Wiggins does, [redacted]

237 [redacted]

[redacted].

109. [redacted]

110. [redacted]

[redacted]

[239] As stated above, I found that the state allocation figure presented in my Opening Report (28.9%) had incorrectly accounted for Puerto Rico's internet population. The adjusted state allocation figure is 28.7%. This adjustment also affects my original violation counts. In this section I use updated violation counts. I also provide updated violation counts based on this adjustment in the exhibits to this report.

[240] [redacted]

[redacted]

111. [redacted]

112. [redacted]

[redacted]

[242] GOOG-AT-MDL-DATA-000486626 to GOOG-AT-MDL-DATA-000488277; GOOG-AT-EDTX-DATA-001116099.

[243] GOOG-AT-MDL-DATA-000488278 to GOOG-AT-MDL-DATA-000508815; GOOG-AT-EDTX-DATA-001116100.

[redacted]

[redacted]

[redacted]

c. In-App Transactions Were Also Affected by Google's Conduct

116. Professor Wiggins argues that in-app transactions should not be included in my count of DTPA violations.[247] As I discuss in detail above, however, there is ample evidence that in-app transactions through AdMob were also the target of Google's deceptive behavior.

117. [redacted]

[redacted]

[247] Wiggins Report, §IV.B.

[redacted]

[249] GOOG-NE-03730264 at -265.
[250] GOOG-DOJ-15971437 at -454.
[251] GOOG-NE-13236353 at -379.

[redacted]

d. Opinions Included in the Wiggins Report Regarding "Business-to-Business" Transactions and Statutes of Limitations Rest on Faulty Legal Assumptions, and he Improperly Removes Transactions That Are Still Subject to the Court's Decision Making Process

118. The Wiggins Report argues that certain transactions should not be included in my DTPA violation count because: 1) certain Plaintiff States disallow recovery of DTPA penalties for business-to-business transactions[253] and 2) certain Plaintiff States prevent DTPA violations from being alleged and penalties claimed after a certain time period.[254] In doing so, he makes certain assumptions regarding application of the laws of various Plaintiff States. However, because it is my understanding that the Court has yet to rule on these legal issues, Professor Wiggins' opinions are premature, and my report correctly includes violation counts associated with the Plaintiff States at issue.

119. First, the Wiggins Report states that I incorrectly include certain Plaintiff States in my report that cannot recover civil penalties for "business-to-business" transactions.[255] Specifically, based on a motion to dismiss filed by Google, Professor Wiggins states that he "understand[s] that the deceptive trade practices acts of Arkansas, Idaho, Indiana, and Utah apply only to consumer transactions," and thus my "transaction counts should not include transactions associated with those four states.[256] It is my understanding, however, that the Plaintiff States

252 [redacted]
253 Wiggins Report, §IV.C.
254 Wiggins Report, §IV.F.
255 Wiggins Report, ¶125.
256 Wiggins Report, ¶125 (citing Google LLC's Motion to Dismiss Pursuant to Rule 12(b)(6) at 25-26, *State of Texas, et al. v. Google LLC*, No. 4:20-cv-00957-SDJ (E.D. Tex. Feb. 8, 2024), ECF No. 224).

addressed the issue in response to Google's motion to dismiss, and specifically contend that the purported "consumer transactions" requirement does not bar DTPA claims in any of the aforementioned Plaintiff States.[257] Because the Court has yet to determine whether these four states can recover civil penalties for "business-to-business" transactions, Professor Wiggins' "understanding" of this legal issue is premature. In any event, as explained above, a reduction in the number of violations would not have a linear reduction in the total penalties. Accordingly, I maintain my opinions with respect to the violation counts for Arkansas, Idaho, Indiana, and Utah in this respect.[258]

120. Next, the Wiggins Report states that my violation counts do not account for the statutes of limitations of various Plaintiff States, and bases his opinion on information Google's counsel provided him "on each Plaintiff State's 'critical date,' which he says "is the date corresponding to the number of years prior to the filing date of Plaintiff States' original complaint (December 16, 2020) that is equal to the length of that state's statute of limitations for DTPA claims."[259] As with the legal issues regarding business-to-business transactions discussed above, it is my understanding that the Plaintiff States addressed the issue of the timeliness of their claims in response to Google's motion to dismiss, specifically contending that the statute of limitations does not apply in enforcement actions in certain states, that Google misstates the statute of limitations for at least one state, Nevada,[260] and that certain legal doctrines – including the discovery rule, the continuing violation doctrine, equitable tooling, and fraudulent concealment –

[257] *See* Plaintiff States' Response to Google LLC's Motion to Dismiss Pursuant to Rule 12(b)(6), *State of Texas, et al. v. Google LLC*, No. 4:20-cv-00957-SDJ (E.D. Tex. Feb. 8, 2024), ECF No. 260, pp. 24-26.
[258] Should the Court find that either Arkansas, Idaho, Indiana, or Utah are barred from recovering civil penalties on the basis of "business-to-business" transactions, I reserve the right to amend or supplement my opinions and violation counts.
[259] Wiggins Report, ¶¶137-140.
[260] I understand that, in his report, Professor Wiggins applies incorrect statutes of limitations for at least Montana, Kentucky, North Dakota, and Missouri. *See* Wiggins Report, ¶¶137-140.

preclude adjudicating the timeliness of claims on a motion to dismiss.[261] Notwithstanding his assumptions about legal issues such as what constitutes a sufficient "disclosure," when a DTPA claim accrues, or the whether certain doctrines apply to toll a statute of limitations, again, Professor Wiggins prematurely attempts to truncate my violation counts on statute of limitations grounds before the Court has ruled on the issue. Accordingly, Professor Wiggins assumptions and "understanding" of various Plaintiff States' statutes of limitations do not change my opinions with respect to the violation counts for those states, which remain the same until such time the Court has ruled on the legal issue of the timeliness of those Plaintiff States' claims.[262]

121. Moreover, I understand that in his report, Professor Wiggins applies incorrect statutes of limitation for numerous Plaintiff States. For example, Professor Wiggins states that the statute of limitations for DTPA violations in Montana, Kentucky, and North Dakota is 2 years,[263] when in fact, I understand that the applicable statute of limitations is 5 years in Montana and Kentucky, and 4 years in North Dakota.[264] Professor Wiggins also states that the applicable statute of limitations in Missouri is 3 years, when in fact, I understand that it is 5 years.[265] In other words, I understand that Professor Wiggins improperly attempts to truncate my violation counts by assuming a shorter statutes of limitations than those that actually apply.

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[261] *See* Plaintiff States' Response to Google LLC's Motion to Dismiss Pursuant to Rule 12(b)(6), *State of Texas, et al. v. Google LLC*, No. 4:20-cv-00957-SDJ (E.D. Tex. Feb. 8, 2024), ECF No. 260, at pp. 11-12, 15-16, 18, 20.
[262] Again, I reserve my right to amend or supplement my opinions and violation counts at such time the Court makes a determination regarding the statute of limitations of the Plaintiff States at issue.
[263] Wiggins Report, Appendix E.
[264] *See* KRS 413.120(2)-(3), 413.150 (Kentucky's consumer protection act has a 5 year statute of limitations); Mont. Code Ann. § 27-2-211 (1)(c)(i) (prescribing an action seeking penalties as exempt from the 2 year statute of limitations period as penalties are a remedy provided only to the state) and Mont. Code Ann. § 27-2-231 (stating "an action for relief not otherwise provided for must be commenced within 5 years after the cause of action accrue"). I also understand that Mont. Code Ann. § 30-14-142 provides that under the MCPA penalties are reserved for actions brought by the state, while Mont. Code Ann. § 30-14-133 governs actions brought by individuals (and provides for compensatory, non-punitive, damages only).
[265] *See* Mo. Rev. Stat. §516.120 (5 year statute of limitations).

122. In short, I understand from counsel for Plaintiff States that these legal issues will ultimately be resolved by the Court.[266] As these are legal issues, I do not provide an expert opinion, and I do not exclude these transactions from my counts of DTPA violations.

e. The Wiggins Report's Method for Allocating Transactions to the States is Flawed

123. The Wiggins Report presents an alternative method to allocate transaction counts to the Plaintiff States using advertiser billing location as provided by Google in a supplemental data production. Using this data, Professor Wiggins argues [redacted]

124. It is my opinion that Professor Wiggins' method suffers from several flaws. First, the customer billing state data produced by Google via several crosswalk files is not intended to match to the AdX data, the basis of my violation count analysis.[269] Furthermore, the data provided by Google on customer billing state appears to be unreliable in some instances. [redacted]

[266] *See* Plaintiff States' Response in Opposition to Google LLC's Motion to Dismiss Under Rule 12(b)(6), February 21, 2024, at §I.B, §II.G, responding to Google LLC's Motion for Dismissal Pursuant to Rule 12(b)(6), February 8, 2024.
[267] Wiggins Report, §IV.D. *See also* Defendant Google LLC's Supplemental Response to Plaintiffs' Second Set of Interrogatories, May 3, 2024, at 4; GOOG-AT-EDTX-DATA-001116100; GOOG-AT-EDTX-DATA-001116099.
[268] Wiggins Report, ¶128 footnote 283.
[269] Defendant Google LLC's Supplemental Response to Plaintiffs' Second Set of Interrogatories, May 3, 2024.
[270] DV360 Impressions - Allocated to States.csv; Google Ads Impressions - Allocated to States.csv; XPP(D) - Publisher State Collapse.csv.
[271] GOOG-AT-EDTX-DATA-001116099-6101.

[redacted] This conflicting information calls into question the reliability of the customer billing state information.

125. Even if I assume that the data on publisher and advertiser billing state is reliable, as I explain above, the geographic location of any auction participant is relevant and if any of the publisher, advertiser, or user is located in one of the Plaintiff States, that transaction should be counted as a potential violation for purposes of calculating an appropriate penalty. Using my estimation of state allocation based on internet users in each Plaintiff State (a proxy for users, or query origin) and Professor Wiggins' estimations of state allocation based on available customer billing locations, I can estimate a combined state allocation assuming that the Plaintiff State share of transactions related to each of these three parties is independent of one another, i.e. that if one participant is located in a Plaintiff State, that makes the location of the other two participants no more or less likely to be in a Plaintiff State. [redacted]

[redacted]

[redacted]

f. The Wiggins Report Inappropriately Cuts Off the Measurement Time Period for Transactions Impacted by RPO, DRSv2, Bernanke, and Equal Footing

126. The Wiggins Report claims that I have assumed that the alleged deception persisted longer than it did, stating that Google's misconducts were disclosed prior to the end of my measurement periods for each of the alleged misconducts – either through public announcements or by virtue of the date of the complaint in this matter.[274] Professor Wiggins argues that the RPO period should end at May 2016,[275] the DRS period should end when DRSv1 ended at November 2016,[276] the Bernanke period (including Alchemist) should end at October 2021,[277] and the Equal Footing misconduct should end at October 2021.[278] Professor Wiggins here argues for the relevancy of public announcements and elsewhere states that "Plaintiffs' theory unduly emphasizes the role of announcements about optimization features…."[279] At any rate, I understand that the Plaintiff States dispute the sufficiency of such alleged "disclosures" in alerting auction participants to Google's deceptive and misleading misconduct,[280] which I understand to be an issue for the trier of fact, and thus I do not alter my violation count based on this issue. If the trier of fact

[274] Wiggins Report, §IV.E.
[275] Wiggins Report, ¶130.
[276] Wiggins Report, ¶¶130-135.
[277] Wiggins Report, ¶¶133-134.
[278] Wiggins Report, ¶135.
[279] Wiggins Report, ¶40.
[280] Fourth Amended Complaint in *State of Texas et al. vs. Google LLC*, In Re: Google Digital Advertising Antitrust Litigation, Civil Action No. 1:21-cv-06841-PKC, May 5, 2023, ¶526.

determines that any measurement period should be altered, the information I have provided through my reports easily allows for such an adjustment to the violation count beginning or ending dates (which I explain above does not necessarily alter the appropriate penalty amount).

127. I understand that Dr. Weinberg also addresses this. First, I understand that he rebuts Professor Wiggins' contention because he explained that, generally, all auctions were affected during the relevant period because of Google's deceptive ecosystem.[281] I also understand that Dr. Weinberg addressed this contention by showing how specific conducts affected auctions during the relevant period and how they were not limited to only the periods that Professor Wiggins assumes.[282]

[redacted]

129. A key assumption underlying this analysis, however, is that the May 2016 purported "disclosure" related to RPO was sufficient to alert auction participants of the existence, mechanisms, and full extent of Google's manipulative RPO program and its effect on auction participants. As I note, however, the Plaintiffs States contend, among other things, that this deceptive, misleading, and partial "disclosure" was not sufficient. Indeed, internal Google documents indicate that Google itself understood that the May 2016 "disclosure" did not fully inform auction participants about RPO. For example, a May 2016 document discussing the not yet

[281] *See* Weinberg Rebuttal Report, §IV.G.; Interview with Dr. Matthew Weinberg, September 8, 2024.
[282] *See* Weinberg Rebuttal Report,§IV.D, §IV.E; Interview with Dr. Matthew Weinberg, September 8, 2024.
[283] Wiggins Report, §VII.A.
[284] Wiggins Report, ¶¶192, 195.

released RPO blog post states that "the feature [RPO] is not directly visible externally" and notes that "buyers may observe changes… and we will monitor how they react."[285] Another internal document containing notes from a May 19, 2016 meeting states "RPO blogpost went live last week, will wait and see how it has been received before deciding on next blogpost with more RPO details."[286] The documents make it clear that the blog post did not contain full details on RPO and thus was not a sufficient disclosure, and as such, a test of this incomplete and insufficient blog post's effect on prices is irrelevant.

g. *The Wiggins Report Inappropriately Excludes Transactions That It Claims "Cannot be Affected" by Google's Misconduct*

130. The Wiggins Report argues that I have included "some transactions that could not have been affected by the alleged deception."[287] To support his argument, he contends that RPO and DRSv1 did not apply to Google Ads,[288] that DRSv2 did not apply to Google Ads and DV360,[289] and that Bernanke *only* applied to Google Ads.[290] In doing so, the Wiggins Report ignores the fact that these deceptive programs ran in parallel for much of the period and that auction participants were either in the dark or being fed deceptive and misleading information as to the existence and mechanisms of these programs, including how they potentially interacted with one another. For example, in a Google email chain from 2017, Nitish Korula states "AdX helps itself at the cost of lower revenue to publishers – this is because they don't know we do debt recollection from buyers / make buyers pay more than they otherwise would have. This is achieved in DRSv2 by non-truthful debt recollection, and *in tDRS potentially by bundling with (parts) of RPO*."[291]

[285] GOOG-AT-MDL-001391101 at -104.
[286] GOOG-AT-MDL-B-004435235 at -245.
[287] Wiggins Report, §IV.G.
[288] Wiggins Report, ¶¶146,149.
[289] Wiggins Report, ¶154.
[290] Wiggins Report, ¶157.
[291] GOOG-DOJ-14162332 at -332 (emphasis added).

Further, I understand from Dr. Weinberg, as cited above, explained that all auctions during the relevant period were affected, regardless of whether the specific auction was directly touched by a conduct.[292]

131. Professor Wiggins goes on to argue that both Alchemist Bernanke[293] and the Facebook NBA impacted zero transactions.[294] Professor Wiggin's argues that Alchemist was not inconsistent with Google's equal footing representations and that there is no reason to think advertisers and publishers would act differently if Alchemist were disclosed.[295] I understand from Dr. Weinberg that Alchemist was deceptive because publishers would have set higher GDN reserves if they knew about the collusive aspect of Alchemist.[296]

132. Professor Wiggins argues that the Facebook NBA impacted zero transactions because [redacted]

133. First off, Professor Wiggins [redacted]

[292] *See* Weinberg Rebuttal Report, §IV.G; Interview with Dr. Matthew Weinberg, September 8, 2024.
[293] Wiggins Report, ¶¶161-163.
[294] Wiggins Report, ¶¶164-165.
[295] Wiggins Report, ¶¶161-163.
[296] Weinberg Rebuttal Report, §IV.C; Interview with Dr. Matthew Weinberg, September 8, 2024.
[297] Wiggins Report, ¶¶164-165.
[298] Wiggins Report, ¶165, footnote 349.
[299] *See* Wiggins Report backup file"FAN_OA_OB" .

[redacted]

134. Second, even if I accept Professor Wiggins' contention that [redacted] I conclude that all transactions post-NBA should be considered to have been impacted, and should be counted as such, regardless of whether Facebook won any post-NBA transactions.

135. Specifically, I understand from Professor Weinberg that Professor Wiggins's logic is flawed [redacted]

[redacted]

[301] *See* Weinberg Rebuttal Report §IV.F; Interview with Dr. Matthew Weinberg, September 8, 2024.

[302] Weinberg Rebuttal Report §IV.F; Interview with Dr. Matthew Weinberg, September 8, 2024.

[303] Weinberg Rebuttal Report §IV.F; Interview with Dr. Matthew Weinberg, September 8, 2024.

[304] Weinberg Rebuttal Report §IV.F; Interview with Dr. Matthew Weinberg, September 8, 2024.

[redacted]

136. [redacted]

137. In conclusion, I find that Professor Wiggins' "corrections" to my DTPA violation count are unfounded and inappropriate given the record produced and the opinions provided by other experts in this matter. While I stand by my violation count as presented in my Opening Report, even if I make an adjustment based on data relating to the geography of the user (where the query originates), publisher entities, and advertiser entities involved in the AdX auction

[305] *See* Weinberg Rebuttal Report §IV.F; Interview with Dr. Matthew Weinberg, September 8, 2024.
[306] *See* Gans Report, § IX.B.
[307] Gans Report, § IX.B; [redacted]
[308] [redacted]
[309] *See* Weinberg Rebuttal Report §IV.F; Interview with Dr. Matthew Weinberg, September 8, 2024.

process, [redacted]

138. Furthermore, I note that I have taken a conservative approach to counting violations in this matter. As I explain above, there are multiple parties involved in each auction, and each of the parties was exposed to and misled by Google's deceptive misconducts. While I only count one violation per auction in my analysis, one could conceivably count multiple violations per auction – one for each party deceived. [redacted] This demonstrates that, contrary to Professor Wiggins' claim that my violation count is inflated, my approach is reasonable, and in fact conservative.

IV. RESPONSES TO SKINNER REPORT

A. The Skinner Report's Critiques of My Display Revenue and Profit Analyses Do Not Affect My Opinion

a. The Skinner Report's Critique Regarding Indirect Costs is Invalid and Irrelevant

139. The Skinner Report asserts that "certain indirect costs are, in many cases, not reflected (or fully reflected) in various internal DVAA P&Ls…which results in measures of operating profitability for DVAA that are overstated relative to those that would be obtained in P&Ls that reflect all relevant costs of the business."[311] This criticism is invalid and/or irrelevant for a number of reasons.

140. First, the information on indirect costs that Professor Skinner is concerned about either does not exist or was not produced in discovery, despite the Plaintiff States' requests for same. As discussed above, and as declared by [redacted] May 24, 2024, the Plaintiff

310 [redacted]

311 Skinner Report, ¶13.b.

States requested financial data for the programs connected to the alleged misconducts.[312] This data, if produced, would allow for a full picture of the direct and indirect costs realized by Google related to the alleged misconducts. However, [redacted] stated that Google could not respond to such a request due to the complexity and the amount of time the response would take.[313] The Skinner Report is silent on [redacted] declaration but insists that my analysis does not include the financial information that Google failed to produce. As such, he should not be allowed to now claim that the internal information Google *did* produce overstates DVAA profits. Moreover, Professor Skinner recognizes that the DVAA P&Ls Google has produced are merely "prepared to provide senior leaders in the display business with 'visibility into the [DVAA] business economics' to inform their business decisions."[314] However, financial statements deemed sufficiently reliable and accurate to be used by Google's senior leaders to understand the DVAA business' economics and make their business decisions should be reliable for the purposes of estimating the DVAA business' profitability, particularly in the absence of other information that can be used to perform such a quantification. Professor Skinner fails to explain why these financial statements should somehow be deemed unreliable for this purpose.

141. Second, even when indirect costs are identifiable, allocation schemes are often based on convenience rather than economic reality.[315] Therefore, further analysis must be undertaken to determine the true underlying economic cost drivers, including to determine whether these costs are incremental given the alleged misconduct.[316] Even though Professor Skinner presumably had or could have requested access to the preparers and users of these P&Ls at Google,

[312] [redacted] Declaration, ¶3.
[313] [redacted] Declaration, ¶9.
[314] Skinner Report, ¶35.
[315] Boushie, Kristopher A., et al. *Calculating and Proving Damages.* Law Journal Press, 2011, §3.02[3] at 3-12.
[316] Boushie, Kristopher A., et al. *Calculating and Proving Damages.* Law Journal Press, 2011, §3.02[3] at 3-11, 3-12.

he failed to identify or quantify a single category of the indirect costs he claims are not reflected (or fully reflected) in the DVAA P&Ls. He also failed to perform an investigation into the true underlying economic drivers of those costs. In fact, he failed to perform any analysis of the true economic drivers of the indirect costs that he claims are reflected on the DVAA P&Ls. If these costs were over allocated to the DVAA business based on convenience rather than economic reality, these financial statements may understate DVAA business profits.

142. Third, the level of precision that Professor Skinner asserts is required to quantify Google's profits from the DVAA segment is unnecessary to determining the amount of the statutory penalties. There is no requirement that penalties be limited to the amount of Google's profits from DVAA or incremental profits from the alleged misconduct. In fact, as explained in my reports, the amount of the penalty can and should exceed Google's incremental profits, particularly if it is to have any meaningful deterrent effect.[317]

143. Finally, I note Professor Wiggins did not identify any indirect costs that were not reflected on Google's DVAA financials. As such, these indirect costs were irrelevant to Professor Wiggins' opinions.

b. The Skinner Report's Critique Regarding Display Revenue is Irrelevant

144. Like Professor Wiggins, Professor Skinner incorrectly argues that revenue and profit related to AdMob, AdSense for Content, and Campaign Manager should not be included in my analysis of Google's display revenue and profit.[318] As I explain above, I disagree with this assessment due to the interrelated nature of display advertising tools and evidence that Google's misconduct was targeted at in-app transactions as well as web transactions.

[317] *See* § III.C; Andrien Opening Report, § IV.F.
[318] Skinner Report, ¶49.

145. Notably, in its interrogatory responses and internal documents, Google lists AdMob, AdSense for Content, and Campaign Manager as "Ad Tech Products" or "core" display products.[319] A Google internal document explains that the [redacted][320] This evidence that Google's entire suite of display products work together and are leveraged as part of a larger strategy to dominate across the AdTech stack is relevant to my analysis as I consider not just the incremental profit of the specific auction programs implemented by Google, but also the larger benefit Google gained from its display business, as well as Google's success overall.

146. Furthermore, as I explain above, there is ample evidence that in-app transactions were also the target of Google's deceptive practices. [redacted]

[319] First Amended Responses and Objections to Plaintiffs' Third Set of Interrogatories, May 24, 2024, p. 4; GOOG-AT-MDL-002189396 at -400.
[320] GOOG-AT-MDL-001057220 at -247-248, -250.
[321] GOOG-NE-07249237 at -237.
[322] GOOG-NE-03730264 at -265.
[323] GOOG-DOJ-15971437 at -454.

[redacted] Once again, this evidence supports that Google's deceptive behavior was also targeted at AdMob and so I include AdMob revenue in my calculations and when considering the benefit Google gained from its deceptive misconducts.

B. The Skinner Report Incorrectly Minimizes Google's Overall Financial Performance and Its Ability to Pay Penalties

147. Professor Skinner takes issue with a certain assertions in my report regarding Google's financial performance from 2013 to the present. Professor Skinner's critiques are focused along three lines, each of which are addressed, in turn, below:

a. The Overall Financial Performance of Alphabet and Google is Relevant for Purposes of Determining an Appropriate Civil Penalty

148. Professor Skinner takes issue with my analysis of the "financial performance of Alphabet and Google as a whole."[326] Professor Skinner suggests that "any analysis that measures and reflects the performance of Google's advertising business in its entirety is overinclusive, in that it includes revenue and operating profit for products not at issue in this matter."[327] However, Professor Skinner proceeds from a flawed premise, that "only certain products within DVAA, which itself is only a portion of Google's advertising business, are at issue in this matter."[328]

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[324] GOOG-NE-13236353 at -379.
[325] GOOG-DOJ-AT-02218994 at -996. [redacted]
[326] Skinner Report, ¶14.
[327] Skinner Report, ¶59.
[328] Skinner Report, ¶59.

149. Rather, as discussed in greater detail *supra*, the products "at issue" in this matter are merely part of the interconnected misconducts which provide both direct and indirect benefits to Google, in service of Google's overall strategy. These misconducts enabled Google to engage in anticompetitive conduct and to build and maintain market share across the display advertising industry.[329]

150. In order to deter future violations, any penalty assessed against Google must, *at a minimum*, eliminate Google's financial incentive to engage in the alleged misconduct. As noted *infra* (see paragraph 36), the economic literature is clear that a penalty to deter misconduct must consider the financial performance of the offender. Put another way, the penalty should have a sufficiently meaningful impact on Google's financial position to deter future violations. It should also deter other potential offenders from similar misconduct. Given Google's extraordinary financial performance over the relevant period (see discussion, *infra*), the appropriate way to determine an appropriate penalty is via reference to the financial performance of Alphabet and Google as a whole.

b. Google's Financial Performance From 2013 to Present Has Been Extraordinary

151. The Skinner Report states that I fail to provide any basis for my assessment that Google's financial performance during the relevant period was "extraordinary," or why such performance is "informative or relevant" to my opinions.[330] He is wrong on both points, and seemingly acknowledges as much when he goes on to state "his basis for this claim largely appears to rest on a comparison of certain financial measures for Alphabet to the average for public companies that are represented in the S&P500 and Nasdaq Composite indices."[331]

[329] *See for example,* Gans Report, § V.C and § V.D.
[330] Skinner Report, ¶64.
[331] Skinner Report, ¶64.

152. It is common to use publicly available data and ratios in financial analysis in the context of litigation, and is in fact one of the skills required of a financial expert.[332] The expert's role in assessing punitive damages (or here, financial penalties) includes "present[ing] information that will help a trier of fact show the defendant's financial position, the effects of possible punitive awards, and other information deemed relevant to the choice of an appropriate award to help a jury."[333] In particular, it is important to analyze liquidity in order to determine an entity's ability to pay a penalty, such that the penalty acts as a deterrent but would not force liquidation of assets crucial to ongoing operations.[334]

153. My analysis of Google's profitability during the relevant time period utilizes publicly available data, financial metrics, and ratios. These measures, including earnings per share (EPS), earnings before interest, taxes, depreciation, and amortization (EBITDA), and net income margin, are standard measures utilized by financial analysts to assess profitability, and are even reported by Google in its own 10-K reports.[335]

154. Moreover, comparison of the financial metrics of a subject entity to market indices, such as the S&P 500 and Nasdaq Composite, is a common, well-accepted method of measuring the performance of a given company relative to its peers. The S&P 500 and Nasdaq Composite are two of the three most-followed stock market indices in the United States. The S&P 500 is a market-capitalization weighted index of 500 of the largest companies traded on either the New York Stock Exchange, Nasdaq, or the CBOE Options Exchange.[336] The Nasdaq Composite Index is a capitalization-weighted index of more than 2,500 stocks listed on the Nasdaq stock

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[332] *Litigation Services Handbook*, *Sixth Edition*, Chapter 2, p. 8, 2.3.a.
[333] *Litigation Services Handbook*, *Sixth Edition*, Chapter 17, p. 3.
[334] *Litigation Services Handbook*, *Sixth Edition*, Chapter 17, p. 5.
[335] *See, for example,* Alphabet 10-K, 2021.
[336] "The S&P 500: The Index You Need to Know," Investopedia, available at **https://www.investopedia.com/articles/investing/090414/sp-500-index-you-need-know.asp**, accessed 8/24/2024.

exchange.[337] The Nasdaq Composite is heavily weighted toward the information technology sector.[338] Professor Skinner questions whether these indices serve as relevant benchmarks for assessing the performance of Alphabet/Google.[339] In so doing, Professor Skinner fails to recognize that the broad-based nature of these indices make them the ideal benchmarks for the company.

155. As noted in my initial report, Google's stock has outperformed both indices. An indication of Google's success is provided by the fact that it has accumulated such a significant amount of cash, cash equivalents and short-term marketable securities that during its 2024 Q1 Earnings Call on April 25, 2024, it announced that it will "be adding a quarterly dividend of $0.20 per share to [its] capital return program as well as a new $70 billion authorization in share repurchases."[340] The market reacted positively to this news as the company's Class A shares rose by 10.2%, the largest single-day gain since 2015.[341] Google's market cap increased from $1.95 trillion to $2.14 trillion, making it just one of four U.S. companies with a market cap of over $2 trillion at that time.[342]

156. Similarly, Google's stock price has grown from approximately $18.08 per share as of January 2, 2013 to $150.92 per share as of September 6, 2024, representing cumulative growth of 734.7% and an annual return of approximately 19.9%.[343] This is 2.72 times the growth of the S&P 500 and 1.68 times the growth of the Nasdaq Composite over the same period.[344]

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337 "What Is The Nasdaq Composite? How Does It Work?" Forbes, available at https://www.forbes.com/advisor/investing/what-is-the-nasdaq-composite/, accessed 9/9/2024. .
338 "What Does the Nasdaq Composite Index Measure?" Investopedia, available at **https://www.investopedia.com/terms/n/nasdaqcompositeindex.asp**, accessed 8/24/2024.
339 Skinner Report, ¶64.
340 Alphabet Inc., Q1 2024 Earnings Call, Apr 25, 2024.
341 Bloomberg.
342 S&P Capital IQ.
343 S&P Capital IQ.
344 The S&P 500 (SPX) and the Nasdaq Composite (COMP) have grown 269.8% and 436.3% respectively since the first trading day of 2013. S&P Capital IQ.

157. Google, founded in 1998, is now the fourth largest company in the world as measured by market capitalization. To place this into context, Google alone has a larger market capitalization than JPMorgan Chase, Johnson & Johnson, Pepsico, IBM, Pfizer, Disney, and Citigroup combined.[345]

158. By nearly any measure, Google's financial performance from 2013 to present has been "extraordinary" as that term is commonly understood.

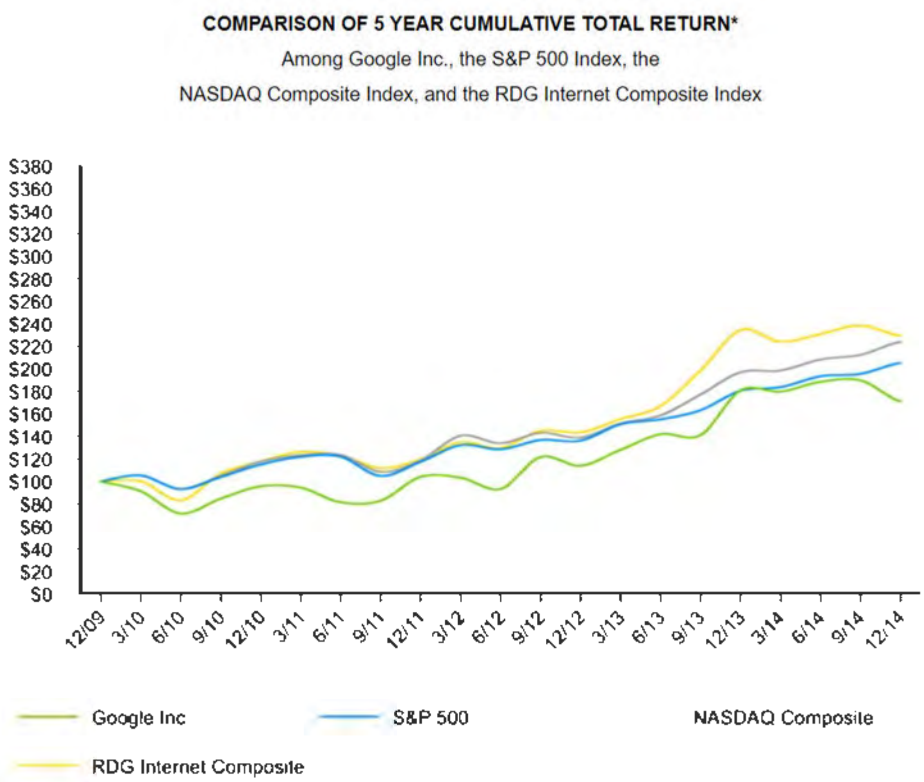
c. Comparison of Google Financial Performance to Relevant Market Indices

159. Professor Skinner expands upon his notion that Google's financial performance is irrelevant to my conclusions by questioning whether "the stock market performance of the collection of companies represented in these indices-which among others, include manufacturers, banks, retailers, and energy companies-serves as a relevant benchmark for assessing the performance of Alphabet."[346]

160. Professor Skinner argues that stock price and market capitalization are forward-looking and would not be germane to Google's misconduct.[347] However, Google itself (both as a standalone entity and under parent company Alphabet) uses stock market returns as a benchmark for historical performance in its annual 10-K reports.[348] Throughout the relevant period, Google's 10-Ks include analysis of the return a stockholder would receive if $100 was invested in Google (or Alphabet) five years previous, as compared to the same investment in indices including the S&P 500 and Nasdaq, as illustrated in **Figure 4** and **Figure 5** below:[349]

[345] S&P Capital IQ.
[346] Skinner Report, ¶64.
[347] Skinner Report, ¶64.
[348] *See, for example* Alphabet 10-K, 2021; Google 10-K 2014.
[349] *See, for example* Alphabet 10-K, 2021; Google 10-K 2014.

FIGURE 4


COMPARISON OF 5 YEAR CUMULATIVE TOTAL RETURN*
Among Google Inc., the S&P 500 Index, the
NASDAQ Composite Index, and the RDG Internet Composite Index
$380
$360
$340
$320
$300
$280
$260
$240
$220
$200
$180
$160
$140
$120
$100
$80
$60
$40
$20
$0
12/09
3/10
6/10
9/10
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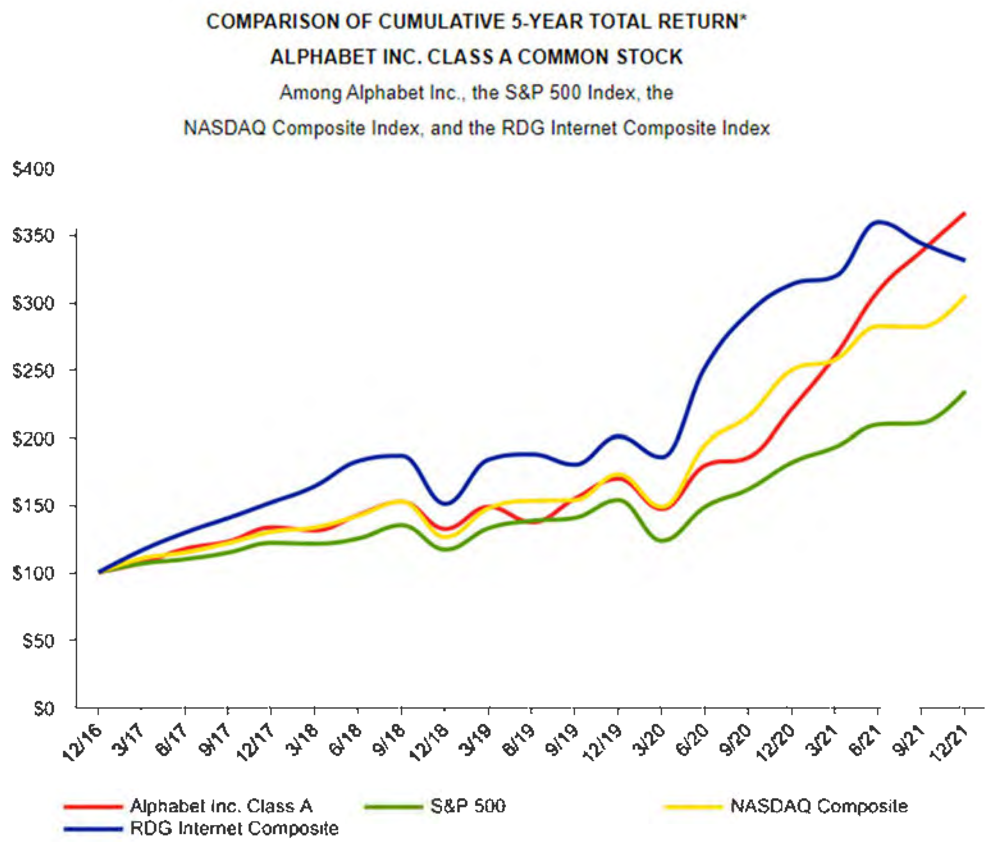
3/14
6/14
9/14
12/14
Google Inc
S&P 500
NASDAQ Composite
RDG Internet Composite

FIGURE 5



161. If Professor Skinner is aware that Google looks to market indices for comparative purposes in their 10-Ks, he is silent about it in his report. However, it is implausible that a comparison that Google itself makes in its 10-Ks would be inappropriate for use in the present litigation. Accordingly, Professor Skinner's criticism vis-à-vis use of these indices is without merit.

C. Updated DVAA P&L Information

162. Professor Skinner notes that the 2022 DVAA P&L I used in my Opening Report contained nine months of actual results and three months of forecast data.[350] While the 2022 financials I relied on did not indicate that the actual results included forecast data, I have

[350] Skinner Report, ¶55.

determined based on further review that there is an updated 2022 DVAA P&L that includes 12 months of actual data.[351] As such, I have updated my 2022 DVAA financial summary, attached here as Updated Opening Report Exhibit 2.

163. Professor Skinner further critiques my analysis when he notes that I used 2022 DVAA P&L data as a proxy for 2023 and that I should have instead used Google's actual 2023 results.[352] In my Opening Report, I noted that "[s]ince P&L for 2023 is unavailable, 2023 P&L line item values are assumed to be equal to 2022."[353] Given the updated financial information that I have now been provided, my updated 2023 DVAA financial summary is included in Updated Opening Report Exhibit 2.

164. While Professor Skinner did not have any observations about a need for me to update the 2021 DVAA P&L data, I observed in the latest financial documents that I received that some of the DVAA 2021 financial results changed from the latest P&L document I relied upon in my affirmative report.[354] As such, I have updated my 2021 DVAA financial summary in Updated Opening Report Exhibit 2.

165. [redacted] The updated 2013-2023 DVAA P&L is included in Updated Opening Report Exhibit 2.

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[351] *See* GOOG-AT-MDL-C-000018044.
[352] Skinner Report, ¶56.
[353] Andrien Opening Report, Exhibit 2.
[354] *See* GOOG-AT-MDL-C-000018044.

V. CONCLUSION

166. In summary, based upon the factors I have considered and the analyses I have performed, I conclude that the critiques presented in the Wiggins Report and the Skinner Report are unfounded and do not cause me to change my overarching conclusions regarding the amount of appropriate penalties due to Google's deceptive misconducts. I find that the appropriate amount of penalties should be no less than the lower bounds for total penalties as presented in my Opening Report, and a reasonable juror could decide that that the appropriate penalty may exceed the higher bounds for total penalties as presented in my Opening Report.

September 9, 2024

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COHERENT ECONOMICS, Austin, TX.
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THE CLARO GROUP, Austin, TX
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FINANCE SCHOLARS GROUP, Austin, TX
President, 2009–2013
Director, 2008–2009

CRA INTERNATIONAL
Vice President, 2007–2008

ERS GROUP
Principal, 2004-2007

LECG (and predecessor companies)
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The University of Texas, McCombs School of Business – Lecturer in the Finance Department (Jan 2020 - present). Teaching the core undergraduate Business Finance course. Also teach applied graduate-level finance class.

Thammasat University, Masters-in-Marketing Program – Visiting Professor of Finance and Economics (2006 – 2018). Taught graduate-level course on Marketing Profitability and Intangible Asset Valuation. Member, MIM Admissions Committee.

The University of Texas, McCombs School of Business – Adjunct Professor of Marketing in the MBA Program (Spring 2012). Taught graduate course on managing a global enterprise.

The University of Texas School of Law - Guest Lecturer: Capital Budgeting and Valuation (January 31, 2011), Economics Damages (April 4, 2011).

Washington University in St. Louis, Olin School of Business – Visiting Lecturer (Summer 2008). Taught MBA course on Marketing Profitability and Intangible Asset Valuation.

Vanderbilt University, Owen School of Business – Guest Lecturer in EMBA Program: Brand Valuation (Fall 2008).

ASSOCIATIONS AND MEMBERSHIPS

Customer Experience Certificate Advisory Board, University of Houston, Bauer School of Business, Board Member 2020-2022

University of Texas MSF Advisory Board, McCombs School of Business, Board Member 2014-2021

Thammasat University Masters-in-Marketing (MIM) Admissions Committee 2012-2019

American Bar Association, Associate Member

American Intellectual Property Law Association, Member; Patent Damages Subcommittee, Member; Trademark Litigation Committee, Member.

Austin Intellectual Property Law Association, Member

International Trademark Association, Former Member

Rice University Career Advisory Board (Former Member)

Austin Youth Hockey Association (Former Board Member)

PUBLICATIONS AND PRESENTATIONS

"Lessons from the Trenches: Damages Experts," CLE presentation and accompanying article for the Texas Bar Association's Advanced Intellectual Property Law course (February 2019). Article co-authored with Chris Bakewell and Leisa Peschel.

"Patent Damages 101," coordinator and panelist for CLE presentation at the AIPLA's 2016 Annual Meeting (October 2016).

"U.S Shale Play Development," CLE presentation to Haynes Boone, Beck Redden, and K&L Gates (All done in 2015).

Valuation expert in mock trial at the *Forensic Finance: Better Bankruptcies Through Better Numbers* Conference in Austin, Texas on September 9, 2015.

"*Brand Imperative: Protecting Your Most Valuable Asset"* (with Benoit and Zerrillo), The Future of Branding, Sage Publications, 2016.

"The Four Stages of Lead Partner Relationship Development" (with Chris Paskach), Claro Newsletter, Summer 2015.

"The Evolution of Trademark Litigation Related to Keyword Searches" (with Prateek Shah), Claro Newsletter, Spring 2015.

"*Protecting Intellectual Assets,"* Presentation at Singapore Management University, February 2015.

"Protecting an Asian Treasure," Asian Management Insights, Vol. 1 Issue 2, November 2014.

"Principles of Business Valuation," CLE presentation to Jones Day in 2015, Nixon Peabody in 2014, Brown McCarroll in 2007, AYLA in 2007, and DYLA in 2007.

"Consumer-Based Conjoint Analysis," CLE presentation to Covington Burling, November, 2013.

"Brand Valuation," Presentation to the Leading Brands Club of Vietnam, Ho Chi Minh City, Vietnam, March 2010.

"Approaches to Brand Valuation in a Global Marketplace," Presentation at the American Intellectual Property Lawyer's Midwinter Meeting, Miami, FL, January 2009.

"Sub-Prime Crisis: How Did We Get Here and What Comes Next?" CLE Presentations to Vinson & Elkins, Winstead, Brown McCarroll, and Fulbright and Jaworski (all done in 2008).

"Working with Financial Experts," CLE presentation to Greenberg Traurig, 2007.

"Understanding Financial Statements," CLE presentation to Hunton and Williams, 2006.

"Lessons from the Trenches: Damages Experts," panelist at the Texas Bar Association's 32nd Annual Advanced Intellectual Property Law Course, Dallas, TX, February 2019. Co-authored article related to topic for the course materials.

Taught Brand Valuation seminar to employees of Universal Robina (Filipino food company), July 31, 2020.

TESTIMONY AND EXPERT REPORTS

Betsy Aubrey et al. v. DOBI Medical International, Inc., et al.
Civil Action No.: A-05-CA-1070-SS. Western District of Texas, Austin Division. Issued Federal Rule 26 report and deposition testimony. 10b-5 Damages case. (2007)

Giddy Up, LLC v. Prism Graphics, Inc. et al.
Civil Action No.: 3:06-CV-0948-BECF. Northern District of Texas, Dallas Division. Issued Federal Rule 26 report and trial testimony related to intellectual property damages. (2007)

Marquis Furniture, Inc. v. Mathis Bros. Furniture Co., Inc., et al.
Case No. CIV-04-1604-F; USDC Western District of Oklahoma. Issued Federal Rule 26 report, Antitrust damages related to price discrimination. (2008)

CenterPoint Energy 2010 Rate Case
Public Utility Commission of Texas, Docket No. 38339. Issued written testimony, dated June 30, 2010 and testified at PUC hearing. Testimony related to cost of services. (2010)

Frank H. Migl, et al. v. Watson Pipe, Inc., et al.
Case No: 07-05-20634-cv; in the 25th Judicial District Court, Lavaca Country, Texas. Issued written report, dated June 28, 2010 and testified at deposition. Testimony related to discount rate for damages calculation. (2010)

Stripes, LLC v. Carlson Restaurants Worldwide, Inc. et al.
Case No: 7:11-CV-00019, USDC Southern District of Texas, McAllen Division. Issued Federal Rule 26 Report, dated January 13, 2012 and testified in deposition. Damages related to trademark infringement. (2012)

Dynamis Therapeutics, Inc. v. Alberto Culver International, Inc.
Case No: 09-773-GMS, USDC District of Delaware. Issued Federal Rule 26 Report, dated April 9, 2012 and testified in deposition. Damages related to the alleged breach of contract of a licensing agreement. (2012)

Securities and Exchange Commission v. Oxford Investment Partners, LLC and Walter J. Clarke
File No: 3-14899, SEC Administrative proceeding. Issued valuation report, dated September 4, 2012. (2012)

Keurig, Inc. v. Sturm Foods, Inc.
Case No: 10-841-SLR-MPT, USDC District of Delaware. Issued Federal Rule 26 Reports, dated November 21, 2012 and December 14, 2012. Testified in deposition on December 19, 2012. Damages related to trademark infringement, trade dress infringement, false advertising and unfair competition. (2012)

Memory Lane, Inc. v. Classmates International, Inc., d/b/a Classmates, et al.
Case No: SACV-1100940-JST (MLGx), USDC Central District of California, Southern Division. Issued Federal Rule 26 Report, dated December 26, 2012. Deposed on April 19, 2013. Testified at trial on February 18, 2014. Testimony addressed liability and damages issues related to trademark infringement. (2012)

Bear Ranch, LLC v. Heartbrand Beef, Inc. American Akaushi Association, and Ronald Beeman
Case No: 6:12-cv-14, USDC Southern District of Texas, Victoria Division. Issued Federal Rule 26 reports on April 12, 2013 and November 22, 2013. Deposed on May 14, 2014 and testified at trial on May 27-28, 2014 and September 11, 2014. Valuation of cattle herd and damages related to breach of contract and fraud claims. (2013)

National Financial Partners Corp. v. Paycom Software, et al.
Civil Action No. 14-cv-7424, USDC Northern District of Illinois, Eastern Division. Issued Declaration in opposition of Plaintiff’s Motion for Preliminary Injunction on April 20, 2015. Issue related to irreparable harm resulting from alleged trademark infringement. (2015)

Avnet, Inc. and BSP Software, LLC v. Motio, Inc.
Case No. 1:12-cv-02100, USDC Northern District of Illinois, Eastern Division. Issued Federal Rule 26 report on December 16, 2015 and a rebuttal report on February 10, 2016. Deposed on March 15 2016. Damages related to patent infringement in the software industry. (2015)

US Imaging, Inc. v. US Imaging Network, LLC et al.
Cause No. 2015-32810, District Court of Harris County, TX, 80th Judicial District. Filed report on January 11, 2016. Liability and Damages related to trademark infringement in the medical industry. (2016). Provided deposition testimony on October 25, 2016.

TinicumCapital Partners II, L.P., et al. v. Liberman Broadcasting, Inc. et al.
C.A No. 11902-VCL, Court of Chancery of the State of Delaware. Filed report on February 17, 2016 and rebuttal report on February 23, 2016. Deposed on February 28, 2016. Case involved valuing the expected outcomes of the FCC Incentive Spectrum Auction under different participatory strategies. Issues related to irreparable harm and business strategy. (2016)

United States of America v. Michael Marr et al.
Case No. CR-14-00580-PJH, US District Court, Northern District of California, Oakland Division. Filed declaration on March 17, 2016. Case involved analyzing foreclosure

auction results to determine if there was evidence that the auction prices were suppressed as a result of collusive behavior by the defendants. (2016)

Linda Suchanek, et al. v. Sturm Foods Inc., and Treehouse Foods, Inc.
Case No. 3:11-cv-00565-NJR-PMF, US District Court, Southern District of Illinois. Filed Expert Report on April 28, 2016. Deposed on May 24, 2016. Case involved analyzing damages issues in a class action lawsuit alleging false advertising in the single-serve instant and micro-ground coffee industry. (2016)

Surgiquest, Inc. v. Lexion Medical, LLC
Case No. 14-cv-0382-GMS, US District Court for the District of Delaware. Filed Expert Report on June 24, 2016. Case involved analyzing damages resulting from false and misleading advertising in the market for medical devices for laparoscopic surgery. rovided deposition testimony on November 3, 2016, and trial testimony on April 6, 2017.

Natural Dynamics, LLC. v. Calm Natural Limited, et al.
Case No. 14-cv-0382-GMS, US District Court for the Western District of Texas, Austin Division. Filed Expert Report on September 23, 2016. Case involved analyzing damages resulting from claims of trade secret misappropriation, breach of contract, and tortious interference in the market for nutraceuticals. Filed supplemental report on October 24, 2016, and a supplemental report on June 16, 2017. Provided deposition testimony on December 5, 2016.

David Weiner, et al. v. Ocwen Financial Corporation, et al.
Case No. 2:14-cv-02597-MCE-DB, US District Court for the Eastern District of California. Filed Expert Report regarding class certification on January 30, 2017 in a class action case that involved analyzing loan level data to determine fees paid by borrowers related to certain mortgage-related valuation services. Filed Rebuttal Expert Reports on April 5, 2017 and May 6, 2019. Filed a Damages Report on March 6, 2019. Provided deposition testimony on February 21, 2017 and on April 5, 2019.

Dina Andren et al. v. Alere, Inc., et al.
Case No. 3:16-cv-01255-GPC-NLS, US District Court for the Southern District of California. Filed Expert Report on June 21, 2017. Case involved class action damages related to claims of deceptive and misleading trade practices in the medical device industry.

Sphero Inc. v. Spin Master, LTD., et al.
Case No: 17-cv-5428, US District Court for the Southern District of New York. Filed Expert Declaration on July 18, 2017 pertaining to irreparable harm and balance of equities related to a preliminary injunction motion. Case involved claims of deceptive patent infringement in the consumer electronics market. Provided deposition testimony on August 17, 2017 and hearing testimony on August 23, 2017.

United States of America v. Jesse Roberts, III
Criminal No: 15-20-JWD-EWD, US District Court for the Middle District of Louisiana. Testified at trial on August 8, 2017. Testimony pertained to analyses of securities trading records in an insider trading case.

Barbara Waldrup, et al v. Countrywide Financial Corporation, et al.
Case No.: 2:13-cv-08833-CAS(AGRx) consolidated with Case No.: 2:16-cv-4166 CAS(AGRx), US District Court for the Central District of California. Filed Expert report on August 28, 2017 and testified at deposition on September 22, 2017. Testimony pertained to class-wide damages resulting from claimed illegitimate appraisals for home mortgages.

Custopharm, Inc. v. Chemworth, Inc., et al.
Case No.: AU:15-CV-00841-RP, US District Court for the Western District of Texas, Austin Division. Filed Expert report on October 17, 2017. Case involved breach of contract claims between two drug development companies. Supplemental report filed on January 10, 2018. Testified at trial on April 18, 2018.

Twin Rivers Engineering, Inc. v. Fieldpiece Instruments, Inc., et al.
Case No.: 2:16-cv-04502-MLH-MRW, US District Court for the Central District of California. Filed Expert report on December 27, 2017. Case involved liability and damages assessments related to antitrust, Lanham Act, and patent infringement claims in the hand-held leak detector industry. Testified at trial on May 31, 2018.

RSL Holding, LLC et al. v. Gregory Smith, et al. AND Iberiabank v. US Rail Services, LLC, et al.
Cause No.: 2016-46164, 164th Judicial District of Harris County, Texas; and Cause No.: 2016-58070, 129th Judicial District of Harris County, Texas. Filed Expert Affidavit on February 5, 2018. Case involved valuation and damages assessments related to breach of contract and fraud claims in post-acquisition dispute.

Total Rod Concepts, Inc. v. Glasforms, Inc., et al.
Cause No.: 14-05-05365, in the District Court for the 410th Judicial District, Montgomery County, Texas. Filed Expert report on February 21, 2018, and provided deposition testimony on March 23, 2018. Case involved damages assessments related to breach of contract and misappropriation of trade secrets claims in the fiberglass sucker rod industry.

S&A Capital Partners, Inc. et al. v. JP Morgan Chase Bank, N.A., et al.
Case No.: 1:15-cv-00293-LTS-JCF, US District Court in the Southern District of New York. Filed Expert report on July 9, 2018 and sur-rebuttal report on December 17, 2018. Case involved damages assessments related to breach of contract and fraud in the market for distressed residential mortgages. Testified at deposition on January 31, 2019.

Greg Friedlander, et al. v. John V. "Jack" McGary
Cause No.: D-1-GN-16-005169, in the District Court for the 261th Judicial District, Travis County, Texas. Filed Expert report on August 1, 2018. Case involved damages

assessments related to breach of fiduciary duty and fraud in the market for the booking of celebrity speakers. Testified at trial on January 17, 2019.

Likarish Enterprises, Inc. v. SkiHi Enterprises, Ltd.
Cause No.: CV-16-0910, in the District Court for the 397th Judicial District, Grayson County, Texas. Filed Expert report on August 7, 2018. Case involved damages assessments related to breach of contract, negligence, and breach of duty to perform in the alcoholic spirits market.

CVS Heath Corporation, et al. v. Vividus, LLC., et al.
AAA Case No. 01-14-0002-0801, American Arbitration Association. Filed Expert report on September 21, 2018. Case involved quantifying antitrust and commercial damages related to claims of collusion and breach of contract in the market for compounding pharmacies.

Sally Ann Reagan v. Ganesh Ramachandran Iyer and Morgan Stanley
FINRA Case No. 17-01985. Filed Expert report on October 10, 2018 and testified at the arbitration hearing on November 1, 2018. Case involved analyzing the riskiness of investments and assessing damages in an arbitration claiming an investor's funds were invested in unsuitable investments.

HEB Grocery Company, LP v. Todd Meagher, et al.
Civil Action No. 4:17-cv-02810, in the United States District Court of the Southern District of Texas, Houston Division. Issued Federal Rule 26 Report, dated November 2, 2018 and testified at deposition on December 19, 2018. Case involved valuing a start-up business and assessing damages associated with the Defendants' counterclaim of trademark bullying.

ExxonMobil, et al. v. Deutsche Telekom, et al.
2014 WIPO Arbitration Rules, CASE NO. WIPOA130218. Issued expert report on February 21, 2019 and a rebuttal report on April 11, 2019 in an International arbitration in London. The report addressed "negotiating damages" resulting from the alleged breach of a settlement agreement related to a prior trademark dispute.

Acceleron, LLC v. Dell, Inc.
Case Number 1:12-cv-04123, US District Court, Northern District of Georgia, Atlanta Division. Issued expert report on May 24, 2019 in a patent infringement dispute involving blade server technology. The report addressed reasonable royalty damages, as well as a critique of the Plaintiff's expert report. Testified at deposition on June 21, 2019. Testified at trial on September 16-17, 2021.

Christopher M. Beuchler, et al. v. James W. Thompson, et al.
Cause Number D-1-GN-17-005884, District Court of Travis County, Texas, 459th Judicial District. Issued preliminary expert report on July 11, 2019 in a business dispute involving open source firewall and router software. The report addressed damages related to claims of fraud, breach of fiduciary duty, and breach of contract, among others.

Vitol Americas Corp. v. Targa Channelview, LLC.
Cause Number 2018-90859, District Court of Harris County, Texas, 80th Judicial District. Filed an initial expert report on December 12, 2019 in a business dispute involving a splitter facility in Channelview, TX. Report quantified benefit of the bargain and restitutionary damages. Provided deposition testimony on January 31, 2020 and on May 12, 2020. Provided trial testimony on September 29, 2020.

Emily Sears, et al. v. Russell Road Food and Beverage, et al.
Case Number 2019-cv-01091, United States District Court for the District of Nevada. Filed an initial expert report on March 2, 2020 in a Lanham Act dispute involving alleged misappropriation and unauthorized publication of the image and likeness of models. Report addressed the likelihood of confusion and economic damages.

Twinwood Cattle Company, Inc. v. American Akaushi Association, et al.
Civil Action Number 18-DCV-250789, in the District Court of Fort Bend County, Texas, 458th Judicial District. Filed an initial expert report on May 7, 2020 in a breach of contract and fraud dispute involving specialized Japanese cattle. Report addressed economic damages. Supplemental report filed September, 18, 2020 and additional rebuttal report filed on March 16, 2021. Testified in deposition on July 8th, 2020 and April 23, 2021. Testified at court hearing on January 29, 2021 and at trial on July 15, 2021.

Jaymo's Sauces, LLC. v. The Wendy's Company
Case No.: 19-cv-1026, in the United States District Court for the Central District of Illinois. Filed an expert rebuttal report on October 23, 2020 in a trademark infringement case involving food products. Report addressed economic damages and unjust enrichment. Filed an affirmative expert damages report on January 29, 2021.

BNSF Railway Company, et al. v. Dynegy Midwest Generation, LLC.
AAA Case No.: 01-18-0001-3283, American Arbitration Association case. Filed an expert report on January 18, 2021 in a breach of contract case involving coal transportation to a power generation facility. Report addressed the issue of the appropriate discount rate for economic damages.

David Yoder and Yoder Naturals, LLC v. YGHR Sales, LLC et al.
Case No.: 8:18-cv-01983 DCC, in the United States District Court for the District of South Carolina, Anderson Division. Filed an expert report on January 22, 2021 in a trademark infringement case involving nutraceuticals. Report addressed the issue of likelihood of confusion. Testified at deposition on March 11, 2021.

In Re: WC South Congress Square, LLC Bankruptcy
Case No. 20-11107-tmd, in the United States Bankruptcy Court for the Western District of Texas, Austin Division. Issued expert report on April 9, 2021 related to the appropriate cram-down interest rate for the debtor's proposed plan of reorganization. Testified at the bankruptcy proceeding on April 15, 2021.

Mid-Atlantic Finance Co., Inc., v. Prime Asset LLC, et al.
Cause No. D-1-GN-19-000954, in the District Court of Travis County, Texas, 250th Judicial District. Case is related to a misappropriation of trade secrets claim in the subprime auto loan industry. Testified at hearing on April 12, 2021, issued expert report on October 5, 2022 and rebuttal expert report on November 21, 2022.

In Re: Residential Capital LLC, et al Bankruptcy
Case Number 12-12020-mg, in the United States Bankruptcy Court for the Southern District of New York. Issued expert report on August 6, 2021 related to a breach of contract claim in the mortgage lending industry. Testified in deposition on October 28, 2021

Daniel Fishbaugh v. Art Bulgadarian et al.
Case No.: 2:20-dv-01135-JWH-RAO in the United States District Court Central District of California Western Division. Issued expert report on September 17, 2021 related to damages incurred by the plaintiff related to numerous causes of action, including copyright infringement, promissory fraud, unfair competition, and breach of contract.

Surveying and Mapping, LLC v. Dustin E. Trousil, et al.
Cause No.: D-1-GN-20-001527 in the United States District Court of Travis County, Texas, 261st Judicial District. Issued preliminary expert report on November 5, 2021. My report addressed damages incurred by the plaintiff related to numerous causes of action, including breach of contract, tortious interference, and misappropriation of trade secrets. Issued an affidavit in the matter on December 12, 2022.

Mary Evans, et al. v. Enterprise Products Partners, LP, et al.
Cause No.: 2019-57694 in the District Court of Harris County Texas, 165th Judicial District. Issued expert report on November 19, 2021. The report addressed issues of class certification related to dispute involving pipelines installed in residential neighborhoods. Provided deposition testimony on February 16, 2022.

Phage Diagnostics, Inc. v. Corvium, Inc.
C.A. No. N19C-07-200-MMJ[CCLD] in the Superior Court in the State of Delaware. Issued expert declaration on December 29, 2021 in a post-acquisition dispute involving technologies that detect food-borne bacteria, such as listeria and salmonella. Expert Reports issues on May 20, 2022 and June 22, 2022. Deposition testimony provided on July 14, 2022 and trial testimony provided on October 25, 2022.

Leon A. Malca v. Rappi, Inc.; Sebastian Mejia
C.A. No. 2020-0152-MTZ in the Court of Chancery in the State of Delaware.
Issued expert report on March 18, 2022 in a shareholder dispute. The report addressed the valuation of a minority interest of a privately held company in the food delivery industry. I issued a response report on April 1, 2022.

National Polypropeline Consultants v. Panatecvh Dervices, S.A.
Arbitration. No. 215208 in the London Court of International Arbitration.

Issued expert report on June 17, 2022 in a fraud and breach of contract case involving drag reducing agents for oil and gas transmission. The report addressed benefit-of-the-bargain damages. I provided deposition testimony on July 27, 2022 and testified at arbitration on August 25, 2022.

Textron Innovations, Inc. v. SZ DJI Technology Co., LTD., et al.
Case No. RG19001604 in the United States District Court for the Western District of Texas, Waco Division. Issues expert report on December 8, 2022 regarding patent damages in a case involving drone technology and a supplemental report on January 19, 2023. Provided deposition testimony on January 24, 2023 and trial testimony on April 18, 2023.

Joshua Chodniewicz, et al. v. Art.com, Inc., et al.
Civil Action No. 6:21-cv-740 in the Superior Court of the State of California, County of Alameda. Issues expert report on February 1, 2023 regarding issues related to WALMART's acquisition of Art.com, including valuations and other financial analyses. Provided deposition testimony on March 24, 2023.

Blue Bottle Coffee, LLC v. Hui Chuan Liao, et al.
Case No. 3:21-cv-06083-CRB in the United States District Court for the Northern District of California. Issued expert report on May 22, 2023 that addressed brands and branding. Provided deposition testimony on July 26, 2023.

Pecos River Exploration Holdings, LLC et al. v. MBL Pecos River Exploration, LLC, et al.
AAA Case No. 01-23-0000-4266. Issued damages report on June 19, 2023 involving the valuation of E&P assets in the Permian Basin. Testified at arbitration on July 14, 2023.

Milton 635 Gravois Road, LLC, et al. v. TRT Holdings, Inc., et al.
Cause number DC-21-11406 in the District Court 44th Judicial District, Dallas County, TX. Issued report on September 25, 2023 involving damages related to alleged fraud in the real estate industry.

Cloud49, LLC v. Rackspace Technology, Inc., et al.
Civil Action number 1:22-cv-229 in the United States District Court for the Western District of Texas, Austin Division. Issued report on September 25, 2023 involving damages related to bid-rigging in the cloud technology services industry.

Sectra Communications AB, et al. v. Absolute Software, Inc. et al.
Case number 2:22-cv-00353-RSM in the United States District Court for the Western District of Washington, Seattle Division. Issued report on December 21, 2023 involving patent damages in a case about mobile VPN technology. Issues rebuttal report on April 12, 2024.

Advanced Micro Devices, Inc. v. Polaris Innovations, LTD.
Civil Action Number 1:23-cv-00304-DAE in the United States District Court for the Western District of Texas, Waco Division. Issued damages report in a breach of contract

and tortious interference case involving contractual licensing relationship between a semiconductor manufacturer and a patent holding company. Report issued on January 15, 2024.

The State of Texas v. Google, Inc.
Cause Number 22-01-88230 in the District Court of Victoria County Texas, 377th Judicial District. Issued expert report on January 16, 2024 addressing Deceptive Trade Practices Act (DTPA) penalties related to alleged violations regarding Google's Location and Incognito mode settings. Issued a supplemental disclosure and provided deposition testimony on May 24, 2024.

Fractus, S.A. v. ADT, LLC d/b/a ADT Security Services
Civil Action Number 2:22-cv-412 in the United States District Court for the Eastern District of Texas, Marshall Division. Issued expert report on March 25, 2024 addressing patent infringement damages related to antennae technology. Provided deposition testimony on April 3, 2024

LifeScan, Inc. v. Jeffrey C. Smith, et al.
Civil Action Number 2:17-cv-5552-CCC-JSA in the United States District Court for the District of New Jersey. Issued Expert report on April 15, 2024 addressing damages related to an alleged fraudulent scheme to take advantage of separate insurance regimes for blood glucose test strip products. Provided deposition testimony on June 25, 2024.

Roche Diagnostic Corp. et al v. Jeffrey C. Smith, et al.
Civil Action Number 2:19-cv-08761-CCC-JSA in the United States District Court for the District of New Jersey. Issued Expert report on April 15, 2024 addressing damages related to an alleged fraudulent scheme to take advantage of separate insurance regimes for blood glucose test strip products. Provided deposition testimony on June 25, 2024.

The State of Texas, et al. v. Google, Inc.
Case No. 4:20-cv-00957 in the United State District Court for the Eastern District of Texas. Issued expert report on June 7, 2024 addressing Deceptive Trade Practices Act (DTPA) penalties related to alleged violations regarding Google's AdTech business.

REPRESENTATIVE CASES

ANTITRUST MATTERS

Performed liability analysis related to an electricity market manipulation claim.

Analyzed liability and assessed damages in a restraint of trade case in the market for HVAC leak detectors. The case also involves claims of patent infringement and Lanham Act violations.

Performed economic damages analyses for a generic pharmaceutical company that was allegedly kept from entering a specific antibiotic market by the branded company through fraudulently obtained patent protection.

Analyzed liability and assessed damages associated with an alleged Resale Price Maintenance Agreement in the "cosmeceutical" industry.

Calculated antitrust damages related to price discrimination and fraud claims in the wholesale home furniture industry.

Examined economic issues related to alleged tying arrangements practiced by a medical device company.

Performed economic analysis related to a Section I and II claim in the laboratory airflow control systems market.

Examined a tying and bundling claim in the television broadcasting industry. Determined economic damages suffered by purchasers of ammonium nitrate due to price fixing.

Performed liability and economic damages analyses, as well as litigation support for an international client accused of collusion in the vitamins industry.

Performed liability and economic damages analyses and litigation support for an international client accused of collusion in the amino acids industry.

CORPORATE RECOVERY

Determined "cram-down" interest rate for bankruptcy proceeding involving commercial real estate company.

Valued a hotel property in Hawaii that was involved in a bankruptcy proceeding.

Performed a fraudulent transfer and preference analysis of the pre-petition transactions to determine avoidability, valued corporate assets, assessed litigation alternatives for additional recoveries, and reviewed debtors' proposed business plan.

Conducted individual practice assessments, market surveys, and damage estimates associated with the failure of a physicians practice management company.

Performed financial analyses related to the pre-petition financing and collateral position of a Chapter 11 telecommunications company.

Analyzed investor claims of legal malpractice to assess recovery possibilities. Also, performed various financial analyses to determine the feasibility of class certification.

INTELLECTUAL PROPERTY

Engaged to quantify economic damages in a patent infringement case involving power converters for computer equipment.

Retained to quantify damages in a patent infringement matter involving drone technology.

Retained to quantify economic damages in a misappropriation of trade secrets case in the sub-prime auto loan industry.

Engaged to address Lanham Act damages in a Lanham Act dispute involving consumer products companies that manufacture and distribute air freshener products.

Engaged to address likelihood of confusion and damages in a trademark infringement dispute involving remote controlled vehicles.

Engaged to quantify damages in a Lanham act case involving false and misleading advertising claims in the timeshare industry.

Engaged to quantify damages to a hospital system resulting from fraud and negligent marketing claims against opioid manufacturers and distributors.

Assessed liability and quantified damages in a misappropriation of trade secrets dispute between two drilling fluids services firms.

Retained by defense counsel to opine on patent infringement damages in a matter involving technology for blade servers.

Engaged by defense counsel to opine on liability and damages in a trademark and trade dress litigation between two companies that manufacture beverage tumblers.

Quantified damages and opined on certain liability issues in a false advertising case involving two medical device companies who manufacture products for laparoscopic surgery.

Engaged to quantify damages and opine on liability issues in a trademark infringement matter involving the health benefits management industry.

Analyzed and rebutted confusion and dilution surveys performed by defense experts in a trademark dispute between a large oil company and a world-renowned entertainment company.

Engaged by plaintiff’s counsel to quantify patent infringement damages in the computer software industry.

Evaluated the Plaintiff’s damages claim and offered affirmative damages opinions in a breach of contract case involving the licensing of patented technology in the cosmeceutical industry.

Engaged by counsel for the defense to evaluate trademark infringement damages in a dispute between an international restaurant chain and a regional convenience store chain.

Engaged by counsel for the defense to evaluate liability and damages in a trademark infringement suit involving an online nostalgia company.

Quantified trademark infringement and false advertising damages in a dispute between two food products companies.

Determine patent infringement damages in a matter involving computer hardware technology.

Calculated damages in a misappropriation of trade secrets case between two computer software firms.

Provided business strategy and licensing assistance to the owner of an Internet patent portfolio.

Determined damages in a patent infringement case involving two “nutraceuticals” companies.

Assessed reasonable royalty and lost profits claim involving baseball training product.

Assessed lost profits and diminution of business value claims involving a misappropriation of trade secrets dispute between a start-up biotechnology firm and a nationally renowned research institution.

Assessed the amount of reasonable royalties due to patent infringement involving two air-jet weaving machine patents. Critiqued lost profits and reasonable royalties claimed by plaintiff.

Determined the amount of reasonable royalties due to patent infringement in the prepaid wireless telecommunications industry.

Engaged by plaintiff to assess lost profits damages for a company in the cardiac rhythm management business. Developed lost profits damages model, critiqued lost profits claimed by defendant, assisted in preparing for expert deposition and trial, and prepared prejudgment interest model and affidavit.

Assessed the amount of reasonable royalties due to patent infringement involving a patent for pet snacks.

VALUATION AND DAMAGES

Retained to quantify damages in an unfair competition case involving a multinational technology conglomerate.

Quantify damages in a breach of contract case involving drag-reducing agents for the oil and gas industry.

Determined damages in a breach of contract case between healthcare technology company and an insurance syndicate.

Engaged by counsel for the defense to value an oil and gas exploration and production company.

Valued natural gas salt-domed storage facility.

Valued natural gas pipeline facility.

Quantified damages in an arbitration dispute involving two joint venture partners in a natural gas trading and marketing business.

Provided cost of services testimony in a PUC rate case.

Engaged by plaintiff's counsel to opine on economic damages in a case involving the resale of underperforming residential mortgages.

Prepared intellectual property valuation for a company in the neuro-marketing field. The valuation report was used for acquisition purposes.

Engaged by defense counsel to provide class certification and damages opinions in a class action case involving ground water contamination.

Quantified class-wide damages for a case involving credit card interchange fees.

Performed valuation of a biotechnology company engaged in a breach of contract dispute involving preclinical and Phase I pharmaceuticals.

Assessed damages associated with breach of a natural gas processing and purchase contract. Determined well connection costs, well deliverability, well capacity, and compression maximums. Also, analyzed gains to producers from gaming nominations to pipelines.

Calculated the termination payment for a portfolio of interest rate swaps determined based on the Loss method as defined in the 1992 International Swaps and Derivatives Association Master Agreement.

Performed class certification analyses for defendant in a large class action lawsuit involving an oil spill in the Gulf Coast region. Work involved analysis of medical class, the Seafood Compensation Program, Property Damages Class,
and other Economic Damages Classes.

Analyzed issues pertaining to a large family enterprise involved in an estate tax examination.

Valued a herd of full-blood, Japanese cattle as part of a damages analysis in a fraud and breach of contract case.

Assessed damages in a breach of contract case involving life settlement policies.

Calculated damages resulting from the withholding of restricted securities in association with an acquisition of a Phase I/Phase II biotechnology firm.

Valued investment advisory business involved in an administrative proceeding with the Securities and Exchange Commission.

Performed damages and liability analyses on a litigation matter involving terminations of interest rate swaps.

Performed a variety of complex analyses on a securities matter involving a large mortgage origination company. Our work entailed quantifying gains from insider trading, as well as analyzing various liability issues.

Provided analysis regarding the appropriate discount rate to employ in a damages calculation involving a failed pipe casing.

Assessed damaged and valued minority interest of a spirits manufacturer related to a post-acquisition dispute.

Provided economic and financial analysis to a large bank involved in a dispute regarding the bank’s involvement in a loan syndicate. The dispute was related to the cable television industry.

Calculated personal injury damages due to a small business owner resulting from an automobile accident.

Performed econometric and financial analyses for the defendants in a large, securities class action case involving initial public offerings.

Calculated damages in a large 10B-5 litigation involving a document management technology and service company.

Assessed the real property value of a Hawaiian hotel involved in a bankruptcy related dispute.

Engaged to provide damages analysis in a 10B-5 litigation involving a defunct broadband company.

Performed valuation of derivative financial instruments in an Enron-related criminal matter.

Quantified damages for defense counsel in a large securities class action case involving a bankrupt energy company.

Calculated damages in a dispute involving nitrogen production units (NPU's) in the oil field services industry.

Performed damages analysis in a 10B-5 litigation involving a medical device firm.

Engaged by counsel for the defense to provide liability and damages opinions relative to a securities litigation involving derivative financial instruments.

Assessed mutual fund trading activities of alleged market timers and late traders for the SEC.

Performed analyses for the state of Texas to assist in analyzing proposed legislation regarding investment disclosure requirements.

Assessed damages due to a large airplane engine manufacturer resulting from faulty equipment produced by a sub-contractor.

Performed a business valuation of a hydroxides manufacturing unit for a multinational client in a breach of contract case.

Conducted damages analysis related to a post-merger dispute between a large express mail company and two of its European affiliates.

Conducted damage analyses related to alleged 10B5 securities violations by a large waste industry company.

Assessed stock and future earn out damages associated with claims of fraud and misrepresentations related to an acquisition of consumer car care products.

Assessed damages claim in a breach of contract case involving two parking services companies.

OTHER MATTERS

Engaged by major international company to perform econometric analyses on the Global Crude Oil Market.

Engaged by mortgage servicing company to determine its ability to pay fines levied against it by the Consumer Financial Protection Bureau (CFPB). The case related to illegal foreclosure practices.

Retained by the SEC in an administrative matter against the executives of a major mortgage servicing company. The engagement entailed evaluating loans for compliance with reps and warranties, as well as determining the gains made by the executives resulting from incorrect disclosures.

Performed analysis regarding the quality of due diligence conducted in a transaction involving a major international restaurant company. The plaintiff, a joint venture partner responsible for West Coast franchise expansion, sued the restaurant chain and its acquirers for breach of contract and fraud.

Performed analyses regarding corporate governance issues for a large accounting firm involved in a litigation case that alleged accounting malpractice.

Retained by a trustee for a mortgage-backed securities structured trust to determine whether mortgage loans in a trust complied with the representations and warranties made about the loans in loan purchase agreements.

Assisted a large national insurance carrier in the divestiture of its healthcare practice.

Performed Y2K readiness assessments on behalf of state insurance regulatory boards.

Managed an engagement to eliminate a large claims backlog for an insolvent insurance carrier.

Retained by trustee to examine a mortgage origination company's policies and practices in the areas of mortgage loan underwriting and mortgage loan sales, as well as its policies and practices related to quality control and quality assurance in these areas.

Helped the City of Pittsburgh value its parking assets and evaluate various alternatives for monetizing them to fund the city's pension shortfall.

Retained by GSE (Government Sponsored Entity) to evaluate its risk management policies and procedures related to its mortgage purchasing activities. In the case, the GSE sued a Big 4 accounting firm for failing to detect fraud at a now defunct mortgage bank during its audits.

Retained by Plaintiff counsel to evaluate class-certification issues in multiple mortgage-backed securities cases.

Materials Relied Upon

Legal Filings
Plaintiff's First Amended Petition in the Matter of the State of Texas v. Google LLC, Cause No. 2201-88230-D, May 19, 2022
Google LLC's Motion to Dismiss Pursuant to Rule 12(b)(6), State of Texas, et al. v. Google LLC, February 8, 2024
Plaintiff States' Response in Opposition to Google LLC's Motion to Dismiss Under Rule 12(b)(6), February 21, 2024
Plaintiff State of Texas's Third Set of Interrogatories, April 1, 2024
Google's Responses to State of Texas's Third Set of Interrogatories, May 1, 2024
Defendant Google LLC's Supplemental Response to Plaintiffs' Second Set of Interrogatories, May 3, 2024

Depositions
[redacted]

Expert Reports
Expert Report of Jeffrey Andrien, June 7, 2024
Expert Report and Backup of Douglas Skinner, July 30, 2024
Expert Report and Backup of Steven N. Wiggins, July 30, 2024
Expert Report of Michael R. Baye, August 6, 2024
Expert Rebuttal Report of Matthew Weinberg, September 9, 2024
Expert Reply Report of David DeRamus, September 9, 2024

Academic Literature
Becker, Gary, "Crime and Punishment: An Economic Approach" Journal of Political Economy (1968)
Litigation Services Handbook The Role of the Financial Expert, Sixth Edition, (2017)
Polinsky, Mitchell and Steven Shavell, "The Theory of Public Enforcement of Law" Handbook of Law and Economics, Volume I (2007)
Raskolnikov, Alex, "Deterrence Theory: Key Findings and Challenges", (2019)
Richard Hildreth's 1864 english translation of Étienne Dumont's Traités de législation civil et pénale (1802), titled Theory of Legislation; by Jeremy Bentham, London: Trübner & Co (1864)
Rohit Chopra & Samuel A. Levine, The Case for Resurrecting the FTC Act's Penalty Offense Authority, 170 U. Pa. L. Rev. 71 (2021)
Shannon Pratt, Robert Reilly, Robert Schweihs, "Valuing A Business," Third Edition
Sheridan Titman & John D. Martin, Valuation: The Art and Science of Corporate Investment Decisions (Addison Wesley, 2007)
Ross, Westerfield, and Jordan, Fundamentals of Corporate Finance, Thirteenth Edition
Berk and DeMarzo, Corporate Finance, Fifth Edition

Financials
Alphabet Inc. SEC Form 10-Q for the quarterly period ended June 30, 2024

Articles & Websites
"AG Racine Announces Google Must Pay $9.5 Million for Using 'Dark Patterns' and Deceptive Location Tracking Practices that Invade Users' Privacy," Office of the Attorney General for the District of Colombia, December 30, 2022, available at https://oag.dc.gov/release/ag-racine-announces-google-must-pay-95-million
"Antitrust: Commission fines Google €1.49 billion for abusive practices in online advertising," European Commission, March 20, 2019, available at https://ec.europa.eu/commission/presscorner/detail/en/IP_19_1770
"Antitrust: Commission fines Google €2.42 billion for abusing dominance as search engine by giving illegal advantage to own comparison shopping service – Factsheet," European Commission, June 27, 2017, available at https://ec.europa.eu/commission/presscorner/detail/en/MEMO_17_1785
"Arizona announces $85M settlement with Google over user data," Associated Press, October 4, 2022, available at https://apnews.com/article/technology-business-lawsuits-arizona-440a27f1e7c2c672d3ccc727439978b4#
"Attorney General Josh Shapiro Announces $391 Million Settlement with Google Over Location Tracking Practices," Office of the Pennsylvania Attorney General, November 14, 2022, available at https://www.attorneygeneral.gov/taking-action/attorney-general-josh-shapiro-announces-391-million-settlement-with-google-over-location-tracking-practices/
"Attorney General Mark Brnovich Achieves Historic $85 Million Settlement with Google," Arizona Office of the Attorney General, October 4, 2022, available at https://www.azag.gov/press-release/attorney-general-mark-brnovich-achieves-historic-85-million-settlement-google
"Attorney General Todd Rokita secures $20 million settlement with Google under same Indiana law being used against TikTok," Office of the Indiana Attorney General, December 29, 2022, available at https://events.in.gov/event/attorney_general_todd_rokita_secures_20_million_settlement_with_google_under_same_indiana_law_being_used_ag
"Competition Commission of India fines Google for abusing dominant position," Reuters, February 8, 2018, available at https://www.reuters.com/article/india-google-antitrust-idINKBN1FS29Z/
"Current GDP," World Bank Group, available at https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?end=2023&start=1960&view=chart
"Draft of Assurance of Voluntary Compliance in the case of States v. Google," available at https://agportal-s3bucket.s3.amazonaws.com/uploadedfiles/WiFi%20-%20AVC%20-%20Final.pdf
"France fines Google and Facebook over cookies," BBC, January 7, 2022, available at https://www.bbc.com/news/technology-59909647

"FTC, States Sue Google and iHeartMedia for Deceptive Ads Promoting the Pixel 4 Smartphone," FTC, November 28, 2022, available at https://www.ftc.gov/news-events/news/press-releases/2022/11/ftc-states-sue-google-iheartmedia-deceptive-ads-promoting-pixel-4-smartphone
"Google and YouTube Will Pay Record $170 Million for Alleged Violations of Children's Privacy Law," FTC, September 4, 2019, available at https://www.ftc.gov/news-events/news/press-releases/2019/09/google-youtube-will-pay-record-170-million-alleged-violations-childrens-privacy-law
"Google Fined – This Time by the Turkish Competition Watchdog," Kluwer Competition Law Blog, November 5, 2018, available at https://competitionlawblog.kluwercompetitionlaw.com/2018/11/05/google-fined-this-time-by-the-turkish-competition-watchdog/
"Google fined $162 mln by India antitrust watchdog for abuse of Android platform," Reuters, October 20, 2022, available at https://www.reuters.com/world/india/india-competition-regulator-fines-google-16195-mln-anti-competitive-practices-2022-10-20/
"Google LLC to pay $60 million for misleading representations," Australian Competition & Consumer Commission, August 12, 2022, available at https://www.accc.gov.au/media-release/google-llc-to-pay-60-million-for-misleading-representations
"Google Loses Antitrust Court Battle With Makers of Fortnite Video Games," The New York Times, December 11, 2023, available at https://www.nytimes.com/2023/12/11/technology/epic-games-google-antitrust-ruling.html
"Google loses appeal over EU antitrust ruling, but fine cut to $4.12 billion," CNBC, September 14, 2022, available at https://www.cnbc.com/2022/09/14/eu-court-backs-antitrust-ruling-against-google-but-reduces-fine.html
"Google pays nearly $392 million to settle sweeping location-tracking case," NPR, November 14, 2022, available at https://www.npr.org/2022/11/14/1136521305/google-settlement-location-tracking-data-privacy
"Google Settles Russian Antitrust Case on Android Phones," Bloomberg, April 17, 2017, available at https://www.bloomberg.com/news/articles/2017-04-17/google-settles-russian-antitrust-case-on-android-phones
"Google to Acquire DoubleClick," Google Press Release, April 13, 2007, available at https://www.sec.gov/Archives/edgar/data/1288776/000119312507084483/dex991.htm
"Google to pay Indiana $20 million to resolve tracking privacy lawsuit," PBS News, December 30, 2022, available at https://www.pbs.org/newshour/economy/google-to-pay-indiana-20-million-to-resolve-tracking-privacy-lawsuit
"Google to Pay $17 Million to Settle Privacy Case," The New York Times, November 18, 2013, available at https://www.nytimes.com/2013/11/19/technology/google-to-pay-17-million-to-settle-privacy-case.html
"Google to pay $29.5 million to settle DC, Indiana lawsuits over location tracking," The Hill, December 31, 2022, available at https://thehill.com/policy/technology/3794301-google-to-pay-29-5-million-to-settle-dc-indiana-lawsuits-over-location-tracking/
"Google to pay $7 million in multistate settlement over Street View," Washington State Office of the Attorney General, March 11, 2013, available at https://www.atg.wa.gov/news/news-releases/google-pay-7-million-multistate-settlement-over-street-view
"Google Will Pay $22.5 Million to Settle FTC Charges it Misrepresented Privacy Assurances to Users of Apple's Safari Internet Browser," FTC, August 9, 2012, available at https://www.ftc.gov/news-events/news/press-releases/2012/08/google-will-pay-225-million-settle-ftc-charges-it-misrepresented-privacy-assurances-users-apples
"Google, US states defend $700 mln Play store antitrust settlement," Reuters, April 18, 2024, available at https://www.reuters.com/legal/transactional/google-us-states-defend-700-mln-play-store-antitrust-settlement-2024-04-18/
"India orders Google to allow third-party payments, slaps on another fine," Reuters, October 26, 2022, available at https://www.reuters.com/technology/india-fines-google-113-million-second-antitrust-penalty-this-month-2022-10-25/
"Introducing Campaign Manager 360," Google Blog, available at https://support.google.com/campaignmanager/answer/10157783?hl=en
"Introducing Google Marketing Platform," Google Blog, June 27, 2018, available at https://blog.google/products/marketingplatform/360/introducing-google-marketing-platform/
"Italy slaps Google's hand with $1.4M fine for not clearly labeling Street View cars," VentureBeat, April 4, 2014, available at https://venturebeat.com/business/italy-slaps-googles-hand-with-1-4m-fine-for-not-labeling-street-view-cars/
"Italy's antitrust regulator fines Google, Apple over data use," Reuters, November 29, 2021, available at https://www.reuters.com/technology/italys-antitrust-fines-google-apple-commercial-use-data-2021-11-26/
"S. Korea fines Google $177 mln for blocking Android customization," Reuters, September 14, 2021, available at https://www.reuters.com/technology/skorean-antitrust-agency-fines-google-177-mln-abusing-market-dominance-2021-09-14/
"The Autorité de la concurrence hands out a €220 millions fine to Google for favouring its own services in the online advertising sector," Autorité de la concurrence, June 7, 2021, available at https://www.autoritedelaconcurrence.fr/en/communiques-de-presse/autorite-de-la-concurrence-hands-out-eu220-millions-fine-google-favouring-its
"The S&P 500: The Index You Need to Know," Investopedia, available at https://www.investopedia.com/articles/investing/090414/sp-500-index-you-need-know.asp
"This Deal Helped Turn Google Into an Ad Powerhouse. Is That a Problem?" The New York Times, September 21, 2020, available at https://www.nytimes.com/2020/09/21/technology/google-doubleclick-antitrust-ads.html
"Turkey fines Google for abusing dominant position," Reuters, April 14, 2021, available at https://www.reuters.com/technology/turkey-fines-google-abusing-dominant-position-2021-04-14/
"What Does the Nasdaq Composite Index Measure?" Investopedia, available at https://www.investopedia.com/terms/n/nasdaqcompositeindex.asp
"Gary Becker," Chicago Booth, available at https://www.chicagobooth.edu/faculty/nobel-laureates/gary-becker
"S. Korea fines Google, Meta billions of won for privacy violations," Reuters, September 15, 2022, available at https://www.reuters.com/technology/skorea-fines-google-meta-over-accusations-privacy-law-violations-yonhap-2022-09-14/

Case Law

"Assurance of Voluntary Compliance in the Matter of Google Inc.," November 13, 2013
"Assurance of Voluntary Compliance in the Matter of Commonwealth of Pennsylvania v. Google, LLC," November 10, 2022
Balderas v. Google LLC, No. 1:20-cv-00143-NF-KHR
"Complaint for Permanent Injunction, Civil Penalties, and Other Equitable Relief in the Matter of Federal Trade Commission and People of the State of New York v. Google LLC and YouTube LLC," September 4, 2019
"Complaint for Injunctive and Other Relief in the Matter of State of Arizona v. Google LLC," May 27, 2020
"Complaint in the Matter of Google LLC, and IHeartMedia, Inc.," Docket Nos. C-4783 and C-4784, February 8, 2023
"Complaint for Injunction, Civil Penalties, and Other Equitable Relief in the People of the State of California v. Google," September 14, 2023
Evans v. Jeff D., 475 U.S. 717, 734, 106 S.Ct. 1531, 89 L.Ed.2d 747 (1986)
Georgia-Pacific v. United States Plywood Corp., 318 F. Supp. 1116, 1120-21 (S.D. N.Y. 1970), modified and aff'd, 446 F.2d 295 (2d Cir. 1971)
Global Settlement Agreement in the case of Balderas v. Tiny Lab Productions, et al.; No. 1:18-cv-00854-MV-JFR
Ketchikan Drywall Services, Inc. v. Immig. and Cust. Enf't, 725 F.3d 1103, 1116 (9th Cir. 2013)

Prism Techs. LLC v. Sprint Spectrum L.P., 849 F.3d 1360, 1369–70 (Fed. Cir. 2017)
“Settlement Agreement in the Matter of the District of Columbia v. Google LLC,” December 29, 2022
"Settlement Agreement in State of Indiana v. Google LLC,” Cause No. 49D01-2201-PL-002399, December 29, 2022
Staton v. Boeing Co., 327 F.3d 938, 964 (9th Cir. 2003)
United States District Court Northern District of California, In Re: Google Play Store Antitrust Litigation, Findings of Fact and Conclusions of Law Re Chat Preservation, Case No. 21-md-02981-JD, March 28, 2023
United States District Court Northern District of California, In Re: Google Play Store Antitrust Litigation, Transcript of Proceedings, December 1, 2023
United States District Court Northern District of California, In Re: Google Play Store Antitrust Litigation, Order of Special Master, July 15, 2024
United States District Court for the District of Columbia, United States v. Google LLC, Case No. 20-cv-3010 (APM), Memorandum Opinion, August 5, 2024
United States v. Gulf Park Water Co., Inc., 14 F.Supp.2d 854, 864 (S.D. Miss. 1998)
Case 3:20-cv-05671-JD Document 591, December 6, 2023
Settlement Agreement in *District of Columbia v. Google LLC* , Case No. 2022-CA-000330 B, February 8, 2023

Public Materials
Bloomberg

State Statutes
Missouri Revised Statute §516.120

Interviews
Interview with Dr. Matthew Weinberg, September 8, 2024
Interview with Dr. David DeRamus, September 8, 2024

Bates Numbered Documents

GOOG-AT-DOJ-01901774	GOOG-AT-MDL-DATA-000559277-61030	GOOG-NE-07249237
GOOG-AT-EDTX-DATA-001116099-6101	GOOG-DOJ-14162332	GOOG-NE-07249243
GOOG-AT-MDL-001057220	GOOG-DOJ-15971437	GOOG-NE-13236353
GOOG-AT-MDL-002178277	GOOG-DOJ-AT-02218994	GOOG-TEX-00124319
GOOG-AT-MDL-C-000018044	GOOG-NE-02633839	GOOG-TEX-00124503
GOOG-AT-MDL-DATA-000486626-8277	GOOG-NE-03730264	GOOG-TEX-00124296
GOOG-AT-MDL-DATA-000488278-508815	GOOG-NE-05311570	

All materials cited in this report and exhibits.
By incorporation, all materials listed in Appendix 2 of the Andrien Report.
I have been provided access to the document database as well as all depositions related to this litigation.

UPDATED OPENING REPORT TABLE 1

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Ratio of State Internet Population to U.S. Internet Population
2013 - 2023

State	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Alaska	0.22%	0.23%	0.24%	0.24%	0.23%	0.23%	0.23%	0.22%	0.22%	0.22%	0.22%
Arkansas	0.79%	0.79%	0.78%	0.80%	0.80%	0.83%	0.84%	0.82%	0.86%	0.86%	0.86%
Florida	5.65%	5.72%	6.32%	6.31%	6.37%	6.47%	6.52%	6.48%	6.54%	6.67%	6.67%
Idaho	0.51%	0.50%	0.51%	0.51%	0.52%	0.54%	0.55%	0.56%	0.57%	0.58%	0.58%
Indiana	2.02%	2.01%	1.96%	1.99%	1.98%	1.98%	1.98%	1.98%	2.02%	2.01%	2.01%
Kentucky	1.30%	1.29%	1.27%	1.30%	1.28%	1.30%	1.30%	1.29%	1.30%	1.31%	1.31%
Louisiana	1.29%	1.26%	1.30%	1.31%	1.29%	1.30%	1.31%	1.29%	1.31%	1.28%	1.28%
Mississippi	0.75%	0.75%	0.74%	0.80%	0.80%	0.81%	0.80%	0.79%	0.80%	0.81%	0.81%
Missouri	1.82%	1.81%	1.80%	1.82%	1.82%	1.81%	1.82%	1.80%	1.81%	1.81%	1.81%
Montana	0.30%	0.30%	0.31%	0.31%	0.31%	0.32%	0.32%	0.32%	0.33%	0.33%	0.33%
Nevada	0.87%	0.86%	0.91%	0.89%	0.90%	0.93%	0.93%	0.93%	0.94%	0.95%	0.95%
North Dakota	0.23%	0.23%	0.23%	0.23%	0.22%	0.22%	0.22%	0.23%	0.23%	0.23%	0.23%
Puerto Rico	0.66%	0.65%	0.73%	0.77%	0.75%	0.72%	0.77%	0.75%	0.84%	0.86%	0.86%
South Carolina	1.32%	1.32%	1.38%	1.44%	1.46%	1.48%	1.49%	1.46%	1.51%	1.54%	1.54%
South Dakota	0.27%	0.26%	0.26%	0.26%	0.26%	0.26%	0.26%	0.26%	0.26%	0.27%	0.27%
Texas	8.32%	8.34%	8.22%	8.46%	8.60%	8.63%	8.74%	8.73%	8.82%	8.97%	8.97%
Utah	1.02%	1.03%	1.00%	0.98%	1.00%	1.01%	1.02%	1.03%	1.03%	1.04%	1.04%
Total	**27.35%**	**27.36%**	**27.96%**	**28.42%**	**28.60%**	**28.84%**	**29.12%**	**28.95%**	**29.38%**	**29.73%**	**29.73%**

Notes: I apply 2022 ratios to 2023 as the U.S. Census Bureau has not yet released 2023 ACS data.
Sources: U.S. Census Bureau Population Estimates and American Community Survey (ACS).

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UPDATED OPENING REPORT EXHIBIT 3

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UPDATED OPENING REPORT EXHIBIT 5

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EXHIBIT 10

THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
SHERMAN DIVISION

STATE OF TEXAS, ET AL., **Plaintiffs,** **v.** **GOOGLE LLC,** **Defendant.**	Civil Action No.: 4:20-cv-00957 (SDJ)

EXPERT REPORT OF PAUL R. MILGROM

DATE: July 30, 2024

HIGHLY CONFIDENTIAL
SUBJECT TO PROTECTIVE ORDER

TABLE OF CONTENTS

I. ASSIGNMENT AND QUALIFICATIONS

A. Qualifications

1. My name is Paul R. Milgrom. I am the Shirley and Leonard Ely Professor of Humanities and Sciences in the Department of Economics at Stanford University and professor, by courtesy, at both the Department of Management Science and Engineering and the Graduate School of Business. I am also the chairman and co-founder of Auctionomics, which designs and assists bidders in high-stakes auctions.

2. In 2020, I was the co-recipient, with Professor Robert Wilson, of the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel, commonly known as the Nobel Prize in Economics, "for improvements to auction theory and inventions of new auction formats." As explained by the Royal Swedish Academy of Sciences: "The new auction formats are a beautiful example of how basic research can subsequently generate inventions that benefit society. The unusual feature of this example is that the same people developed the theory and the practical applications. The Laureates' ground-breaking research about auctions has thus been of great benefit, for buyers, sellers and society as a whole."[1]

3. Earlier in the same year, I was also named a Distinguished Fellow of the American Economic Association. The Distinguished Fellow citation describes me as "the world's leading auction designer, having helped design many of the auctions for radio spectrum conducted around the world in the last thirty years, including those conducted by the US Federal Communications Commission (ranging from the original simultaneous multiple

[1] The Royal Swedish Academy of Sciences, "The quest for the perfect auction," Nobelprize.org (2020), https://www.nobelprize.org/uploads/2020/09/popular-economicsciencesprize2020.pdf, at 6-7.

round auction with activity rules, to the recent incentive auction for repurposing broadcast spectrum for modern uses). His applied work in auction design and consulting has established new ways for economists to interact with the wider world. He is also a theorist of extraordinary breadth, who has provided (and still continues to provide) foundational insights not only into the theory of auctions (including his 1982 paper with Weber), but across the range of modern microeconomic theory."[2]

4. Continuing, the citation notes that "[h]is work has been widely recognized. He is a member of the National Academy of Sciences and the American Academy of Arts and Sciences. He has received major prizes, including the 2008 Nemmers Prize, the 2012 BBVA Foundation Frontiers of Knowledge Award, the 2014 Golden Goose Award (with McAfee and Wilson), the 2018 CME Group-MSRI Prize in Innovative Quantitative Applications, and the 2018 John J. Carty Award for the Advancement of Science (with Kreps and Wilson). He is the dissertation advisor of many successful economists."

5. I have been Professor at Stanford University since 1987. My prior academic appointments were at Yale University (from 1982 to 1987) and Northwestern University (from 1979 to 1983). In 2023, I was also a Distinguished Research Professor at the Simons Laufer Mathematical Sciences Institute (supported by the Alfred P. Sloan Foundation). I hold a Ph.D. in Business from Stanford University (conferred in 1979), a M.S. in Statistics from Stanford University (conferred in 1978), and an A.B. in Mathematics with high honors from University of Michigan (conferred in 1970).

[2] American Economic Association, "Paul Milgrom, Distinguished Fellow 2020" (2020), https://www.aeaweb.org/about-aea/honors-awards/distinguished-fellows/paul-milgrom.

6. At Stanford University, I teach undergraduate and graduate courses in microeconomic theory and market design. *Market design* is a field of research in economics, management science and computer science, which includes the study of auctions.[3]

7. My academic research on auctions and economic theory has been published in a number of peer-reviewed journals in economics, including *Econometrica, American Economic Review, Journal of Political Economy, Quarterly Journal of Economics, Journal of Financial Economics, Games and Economic Behavior, Journal of Economic Perspectives, Journal of Economic Theory,* and *Journal of Mathematical Economics.*

8. In the online display advertising industry, I was engaged to give commercial advice to two companies. From 2007 to 2008, I advised Yahoo! Inc., which was a leading online publisher and operator of an ad network. From 2009 to 2017, I occasionally advised OpenX, a supply-side platform, on auction design-related issues. As part of this work, I

[3] The National Bureau of Economics Research (NBER) has a market design working group, which it describes as one that "studies market institutions such as auctions, queues, assignment rules in school systems, clearinghouses, and tradeable permit systems. It emphasizes the role of institutional design in determining market outcomes and the well-being of market participants." NBER, Market Design (accessed Sep. 27, 2023), https://www.nber.org/programs-projects/programs-working-groups%23Groups/market-design.

The Institute for Operations Research and Management Science (INFORMS) has an "Auctions and Market Design Cluster," for which the "[a]pplications include procurement auctions, spectrum auctions, kidney exchanges, labour markets, or digital advertising markets." INFORMS, "About AMD - Auctions and Market Design" (accessed Sep. 27, 2023), http://connect.informs.org/auctionsandmarketdesign/about-us/aboutamd.

The Simons Laufer Mathematical Sciences Institute of University of California at Berkeley had a 2023 program entitled "Mathematics and Computer Science of Market and Mechanism Design." It explains that "economists and computer scientists have collaborated with mathematicians, operations research experts, and practitioners to improve the design and operations of real-world marketplaces." SLMath, "Mathematics and Computer Science of Market and Mechanism Design" (2023), https://www.slmath.org/programs/333.

At Stanford University, I teach an economics course on market design, which has coverage including "the design of platforms and exchanges, with applications to internet markets." Stanford University, Stanford Bulletin (2023), https://explorecourses.stanford.edu/search;jsessionid=zg9iqiunv63g16z0qr48bmb90?q=ECON+136%3a+Market+Design&view=catalog&filter-coursestatus-Active=on&academicYear=20232024.

co-invented an auction design that was patented by OpenX, entitled "*Impression allocation system and methods using an auction that considers losing bids*."[4]

9. In 2017-2018, I was a visiting research scholar at Google, studying the economics and pricing of cloud computing.

10. I attach my curriculum vitae in Appendix A, which provides further biographical details, including details of my previous work as an expert witness.

B. Assignment

11. The State of Texas and a group of other states (collectively, "Plaintiffs"[5]) have alleged that Google has violated the Sherman Act and state antitrust and consumer protection laws via "deceptive trade practices and anticompetitive conduct."[6]

12. I have been retained on behalf of Google LLC ("Google") to analyze and assess the economic effects of Google's online display advertising auction practices that Plaintiffs and their experts allege to be deceptive and/or anticompetitive. Specifically, I studied the economic effects of the following auction practices:

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[4] Milgrom, P.R., Cunningham, S.J., & Beck, M.R. (2023). *U.S. Patent No. 11,574,358-B2.* Washington, DC: U.S. Patent and Trademark Office.

[5] The Plaintiffs consist of the States of Texas, Alaska, Arkansas, Florida, Idaho, Indiana, Louisiana, Mississippi, Missouri, Montana, Nevada, North Dakota, South Carolina, South Dakota and Utah, and the Commonwealths of Kentucky and Puerto Rico. *State of Texas et al. v. Google LLC*, Fourth Amended Complaint, May 5, 2023 ("Fourth Amended Complaint").

[6] Fourth Amended Complaint ¶ 30.

a. *Buy-side DRS*, *Project Bernanke*, *Global Bernanke* and *Alchemist*[7]: Google Ads' bid optimization programs for AdX auctions designed to maximize the value of impressions won by Google Ads, without increasing its overall revenue share.

b. *Project Bell*[8]: Google Ads' practice of reducing bids to publishers that query AdX multiple times for the same impression.

a. *Project Elmo*: a budget management feature on DV360 and Google Ads to ensure that Google made consistent bids on behalf of its advertisers across all bid requests received for a given end user within each minute.

c. *Projects Poirot and Marple*[9]: DV360's and Google Ads' programs to detect ad exchanges using non-second-price auction formats and adjust bids to maximize advertiser profits in those auctions.

d. *Dynamic Allocation (DA)*: a procedure to increase yields on publisher impressions by inserting Google's real-time auctions into publishers' earlier sequential "waterfall" allocation process.

e. *Enhanced Dynamic Allocation (EDA)*: a technology that dynamically allocates impressions between guaranteed contracts and an auction process to increase publisher revenues and improve efficiency.

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[7] None of the Plaintiffs' allegations are about Buy-side DRS, but I have analyzed it in this report as it is a close precursor of Project Bernanke.

[8] In this report, I use "Project Bell" or "Bell" to refer to what Google internally called Bell v.2 (*i.e.*, not the program "Global Bernanke," which was also at times called Bell v.1).

[9] None of the Plaintiffs' allegations are about Project Marple, but I have analyzed it in this report as a closely related program to Project Poirot.

f. The so-called *"last look"*: a side effect of the way that some publishers configured header bidding to integrate with DFP causing bids from AdX bidders to be received after header bids had been received by the publisher.

g. *Reserve Price Optimization (RPO)*: a DFP feature that automatically increased floor prices for impressions when Google detected that a publisher set a floor below the revenue-maximizing level.

h. *Sell-side Dynamic Revenue Share (DRS)*: AdX's practice of varying its revenue share on individual impressions to increase the number of impressions it sold, without increasing its overall revenue share.

i. *Open Bidding*: Google's auction design to integrate real-time bids from other exchanges into the sale of impressions.

j. *Unified First Price Auction (UFPA)*: Google's auction redesign that compares bids for impressions from all bidders on the same first-price basis.

k. *Uniform Pricing Rules (UPR)*: a feature that allows publishers to configure and manage floor prices that apply equally to all buyers (*i.e.*, exchanges and other demand sources) participating in Google's UFPA.

C. Compensation

13. I am compensated at the rate of $1,800 per hour for the time I work on this matter, which is my current regular consulting rate. I also receive a share of the profits of Auctionomics Inc., which has, in this matter, provided research support and assisted in the preparation

of this report under my direction and supervision. My compensation is not contingent on my findings, the testimony I may give, or the outcome of this case.

II. SUMMARY OF OPINIONS

A. Google's Programs Benefited Its Customers

14. Plaintiffs allege that "Google's exclusionary conduct has caused a wide range of anticompetitive effects, including higher prices, reduced output, lower quality services, reduced innovation, the exit of rival firms, and foreclosed entry in the relevant antitrust markets[.]"[10] After analyzing the Google practices listed in Paragraph 12, I find instead that these practices represent competition on the merits, providing benefits to Google's customers: its advertisers, publishers, or both.

15. I now provide brief summaries of my analyses of Google's programs and their effects, with details and supporting evidence to appear in later sections of this report.

a. Google Ads' bid optimization programs—buy-side DRS, Bernanke, Global Bernanke, and Alchemist—optimized bids into the AdX auction to increase the total value of impressions won by Google Ads advertisers. Whenever these programs increased Google Ads' win rate (increasing the number of impressions won by Google Ads advertisers), they also increased the surplus enjoyed by Google Ads advertisers. Google Ads' experiments suggest that its bid optimization programs also benefited publishers in the form of increased revenues and a reduction in the number of unsold impressions, expanding output. Bernanke achieved those goals without turning AdX into a "third-price auction," as alleged by Plaintiffs.[11] While the specific details of Project Bernanke were not

[10] Fourth Amended Complaint ¶ 502.

[11] Fourth Amended Complaint ¶ 299 ("As addressed below, Google's secret Bernanke program surreptitiously switched Google's AdX exchange from a second-price auction to a third-price auction on billions of impressions per month."). *See also* Expert Report of J. Chandler (Jun. 7, 2024), at ¶ 359 ("In Project Bernanke, participants believed

communicated to advertisers or publishers, the strategies of bidders in auctions are routinely kept confidential for the benefit of those bidders. Buy-side tools of other ad tech companies used similar bid optimization programs, and I am not aware of cases in which the bidding algorithms of those tools are made public.

b. Project Bell benefited Google Ads advertisers by protecting them from a publisher tactic called multi-calling, which would otherwise reduce their advertiser surplus. Multi-calling involves calling AdX multiple times for the same impression. Project Bell also benefited non-multi-calling publishers who might otherwise have received lower bids from advertisers seeking to protect themselves against multi-calling. Project Bell did not "punish" publishers who partnered with Google's competitors or turn AdX into a "third-price auction," as alleged by Plaintiffs.[12] Buy-side tools of other ad tech companies also modified bids in response to multi-calling.

c. Projects Poirot and Marple benefited advertisers using DV360 and Google Ads, respectively, by optimizing their bids to prevent advertisers from overpaying when auctions were not second-price auctions. Optimal bidding strategies can sometimes be complex to compute, so by automating this bid optimization, Poirot and Marple made bidding simpler and more profitable for Google's advertiser

they were in a second-price auction, but it was essentially a third-price auction, with the publisher receiving the third-highest bid, the advertiser paying the second-highest bid, and Google pooling the difference to manipulate other auctions.").

[12] Fourth Amended Complaint ¶¶ 311 ("If a publisher does not give preferential access to AdX, then Bell would drop their auctions from second- to third-price auctions[.]"), 557 ("Bell punished publishers who did this by dropping second price bids returned to publishers that had not enabled Dynamic Allocation (or otherwise ranked it near the top of their waterfall)").

customers. Buy-side tools of other ad tech companies used similar automatic bid shading programs for non-second-price auctions.

d. Project Elmo benefited Google Ads and DV360 advertisers by ensuring that their budgets were not depleted too quickly as a result of multi-calling by publishers and bid duplication by exchanges. Bid duplication occurs when an exchange sends multiple bid requests for the same impression in an attempt to elicit higher bids from one of those calls. By blocking the harmful effects of bid duplication, Elmo reduced spending on exchanges engaged in that practice and increased spending on other exchanges, while benefiting advertisers by spending their budgets more effectively. Project Elmo did not treat exchanges participating in header bidding differently from non-header bidding exchanges, as alleged by Plaintiffs.[13]

e. Dynamic Allocation (DA) benefited publishers by introducing real-time auctions that allowed them to sell impressions on AdX when the AdX offer was larger than the publisher's expected price from any other demand source. DA also benefited advertisers, allowing them to purchase impressions on AdX while paying *only* the amount they needed to bid to win impressions, and not more. Supply-side tools of other ad tech companies developed ad allocation mechanisms similar to DA.

f. Enhanced Dynamic Allocation (EDA) benefited publishers by allocating impressions between direct deals and remnant demand in a way that increased publisher revenues without compromising publishers' ability to fulfill direct

[13] Fourth Amended Complaint ¶ 403 ("[Elmo] decreased overall ad spend on any exchange that it suspected to meaningfully engage in header bidding.").

contracts with advertisers. EDA also expanded output by reducing the number of unsold impressions and helped advertisers to win the impressions they valued most. Supply-side tools of other ad tech companies implemented similar programs to optimize between direct deals and remnant demand.

g. The so-called "last look" of AdX over header bidding was not a Google-designed program but a side effect of the way that some publishers configured header bidding to integrate with Google's ad server. Publishers who used header bidding could benefit from offering AdX the chance to bid on inventory because it allowed them to earn higher revenues and integrate the other services that Google Ad Manager provided. The so-called "last look" did not create an inherent advantage for AdX bidders. Non-Google ad servers also used ad allocation mechanisms resulting in a similar "last look."

h. Reserve Price Optimization (RPO) increased publisher revenues and simplified revenue optimization for publishers in the AdX second-price auction. RPO did not alter the auction format, and it never unsealed bids received in an auction to set the floor price for that auction. Because publishers could adjust floor prices on the basis of historical data before and after the introduction of RPO, a surplus-maximizing bidder would need to account for the possibility that future floor prices would change in response to their bids both when RPO was in place and before.

i. Sell-side Dynamic Revenue Sharing (DRS) benefited publishers by allowing them to sell more inventory and increase their total revenues from the sale of

impressions. Sell-side DRS also expanded output by reducing the number of unsold impressions, allowing advertisers to win more inventory. Google's intention to use auction optimizations like sell-side DRS was transparently communicated to auction participants on Google's Help Center pages. Non-Google exchanges and supply-side intermediaries implemented similar programs to increase the win rates of their advertisers.

j. Open Bidding benefited publishers by allowing them to incorporate bids from non-Google exchanges into an auction among bids from multiple auctions—an "auction of auctions"—leading to higher auction revenues without the drawbacks of alternative approaches, including header bidding. Open Bidding also benefited advertisers on competing exchanges by increasing the total inventory open to competition from non-AdX bidders. The transition to the Unified First Price Auction allowed the auction of auctions to replicate the result of a first price auction in which all bidders are treated equally.

k. Unified Pricing Rules (UPR) allowed publishers to set floor prices natively in Google's supply-side platform (Google Ad Manager), but required those floors to apply uniformly across exchanges and demand sources. UPR protected multi-homing advertisers from price-fishing, a tactic in which some publishers would call bidders on different exchanges using different floor prices to induce them to make an unnecessarily high bid in at least one exchange. Without UPR, publishers would have incentives to engage in price-fishing, making coordinating bids from different channels more difficult for advertisers. Advertisers' likely responses—using fewer channels or reducing all their bids—could reduce

efficiency and harm publishers who did not engage in price-fishing. Non-Google ad tech intermediaries also introduced rules requiring floor prices to be uniform across bidders.

B. Analyses of Google's Programs by Plaintiffs and Their Experts Are Marred by Omissions and Errors

16. My opinions about Google's auction practices differ from those of Plaintiffs and their experts for four key reasons. *First*, Plaintiffs and their experts systematically overlook or understate the significant benefits that each of Google's auction practices confer on its advertiser and publisher customers. *Second*, Plaintiffs' experts exaggerate the challenge for multi-sided platforms of balancing the interests of buyers and sellers and omit the benefits that Google's integrated structure provides for its advertiser and publisher customers. *Third*, the analyses of Google's auction conducted by Plaintiffs' experts underestimate or understate the incentives for publishers and advertisers to optimize to improve their returns from display advertising. *Fourth*, those analyses underestimate or understate the prevalence and effectiveness of experimentation for optimizing returns. These omissions and errors lead Plaintiffs and their experts to false conclusions that Google's auction programs were anticompetitive and/or deceptive. Correcting these errors, a different explanation emerges as more consistent with the design of the technical programs at issue: each program helped Google compete on the merits for customers by providing greater benefits to advertisers, publishers, or both groups, including expanding output by enabling more matches to be made between advertisers and end users viewing publisher inventory.

17. I now discuss these four categories of omissions and errors individually, with additional details and supporting evidence to appear in later sections of this report.

1. Plaintiffs' Experts Overlook or Understate the Benefits of Google's Programs for Its Customers

18. Plaintiffs' experts focus their analyses on the effects of Google's programs on competitors, but in doing so, they largely overlook the significant benefits of Google's programs for its advertiser and publisher customers. Each of the Google programs I have studied benefits advertisers, publishers, or both, and, taken together, they have been output-expanding, that is, they have fostered the significant growth of online display advertising. Designing products that benefit consumers is the essence of competition on the merits, and the demand for Google's well-designed products contributed to the industry's (and the company's) growth.

19. To assess the effects of Google's auction programs on its advertiser and publisher customers, one must consider those programs in the historical context of the time of their introduction. To assist in that historical assessment, I provide a timeline of the introduction of Google's auction programs in Figure 1. The time period covered by Figure 1 was one marked by rapid technological development and growth of online display advertising. When each new Google program was introduced, it raised advertiser surplus or publisher revenues or both, and it sometimes created a standard on which future improvements could be built.

20. In several cases, Plaintiffs' and their experts' assessments of Google's conduct overlook this historical context. I provide a non-exhaustive list of examples from Plaintiffs' experts below:

a. Plaintiffs' experts allege that publishers were harmed because Dynamic Allocation (DA) integrated real-time bids only from AdX,[14] but these allegations ignore the fact that real-time bidding was introduced into DA during the nascency of ad exchanges as a technology. At that time and in that context, industry participants viewed the main challenge not as exchange interoperability but "driving adoption," because "[t]he exchange represents a rather significant shift in how we typically transact, so adjusting to that for both buyer [and] seller takes some time."[15] DA eased this transition by making DA's design compatible with publishers' previous ad sales configurations, and Google drove adoption of the ad exchange technology partially through its integration of demand from Google Ads (then AdWords).[16] By overlooking this historical context, Plaintiffs ignore both the challenges that Google overcame in developing DA and the major benefits DA created for publishers.

[14] *See, e.g.*, Expert Report of P. Pathak (Jun. 7, 2024), at ¶ 19 ("Google's Dynamic Allocation and Enhanced Dynamic Allocation distorted the playing field in its favor because Dynamic Allocation was solely granted to AdX and not competing exchanges."); Expert Report of J. Gans (Jun. 7, 2024), at ¶ 569 ("DA allowed AdX, and only AdX, to compete in real-time against all non-guaranteed inventory [...] Google understood that publishers were harmed by this feature of DA and that Header Bidding was the result of publishers seeking better prices.").

[15] Email from [redacted] to adx-updates@google.com, "FW: comments from industry players on AdX 2.0 on AdExchanger.com this evening" (Sep. 22, 2009), GOOG-AT-MDL-B-003180112, at -114.

[16] *See, e.g.*, Email from [redacted] to adx-updates@google.com, "FW: comments from industry players on AdX 2.0 on AdExchanger.com this evening" (Sep. 22, 2009), GOOG-AT-MDL-B-003180112, at -114 ("This will only work if Google can bring significant demand for display inventory into the system. They can maximize the demand by accepting bids from AdWords and also via networks through the AdX 2.0 channel.").

b. Plaintiffs' experts allege that Enhanced Dynamic Allocation (EDA) reduced the revenue that publishers could expect to earn from direct deals.[17] But Plaintiffs' experts overlook the fact that, during a period in which real-time bidding was rapidly growing in popularity, EDA helped publishers solve the difficult problem of how to allocate display inventory between direct deals and remnant demand channels. EDA solved this important problem by making it easier for publishers to monetize their inventory using *both* direct deals and remnant demand, and, as I discuss in Section IX, EDA led to revenue increases for publishers, without reducing the performance of direct deal advertising.

c. Plaintiffs' experts allege that Project Bernanke harmed non-Google exchanges and ad buying tools and created inefficiencies "by enabling lower-value advertisers to win impressions instead of higher-value ones."[18] Logically, the truth of this allegation depends not just on Google's strategy, but also on the bidding strategies of non-Google buying tools. What Plaintiffs' experts overlook is that, when Bernanke was introduced, many buying tools were submitting just a single bid into the Google AdX second-price auction. Such a one-bid policy may incentivize an advertiser or buy-side tool to submit bids into the AdX auction

[17] *See, e.g.*, Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 137 ("In my opinion, Enhanced Dynamic Allocation likely led to an increase in win rate and increase in revenue for AdX and reduced the value of direct deals for advertisers, which would in turn decrease the revenue earned by publishers via direct deals.").

[18] Expert Report of P. Pathak (Jun. 7, 2024), at ¶ 181; *see* Expert Report of M. Weinberg (Jun. 7, 2024), at Section VIII.D.1 ("Under Projects Bernanke and Global Bernanke, GDN increased its revenue at the expense of non-Google ad-buying tools[.]"), Section VIII.E.1 ("Projects Bernanke and Global Bernanke did not benefit GDN advertisers, but decreased win rates for advertisers using non-Google ad buying tools[.]"); Expert Report of J. Gans (Jun. 7, 2024), at Section VIII.B.2 ("Bernanke harmed competition in the market for ad buying tools for small advertisers[.]"). *See also* Expert Report of M. Weinberg (Jun. 7, 2024), at Section VIII.C.2 ("Projects Bernanke and Global Bernanke can lead to a reduction in ad quality[.]"). Professor Weinberg's arguments only follow "if GDN advertisers tend to display lower quality ads," *id.* at ¶ 247, but he offers no justification for why this presupposition is true. *See also* Expert Report of J. Gans (Jun. 7, 2024), at ¶ 759 ("Bernanke enables lower-quality ads to be transacted and displayed on publishers' properties.").

higher than the advertiser's true value for the impression.[19] Given that possibility, if Google Ads had continued to bid its advertisers' values into the AdX second-price auction, those advertisers would have been *disadvantaged* relative to non-Google Ads advertisers. Without a bid optimization strategy like Bernanke for Google Ads, the allocation of advertising inventory would have been inefficient for the *reverse* of the reason identified by Plaintiff's experts: non-Google Ads advertisers with lower values could win impressions at the expense of Google Ads advertisers with higher values.

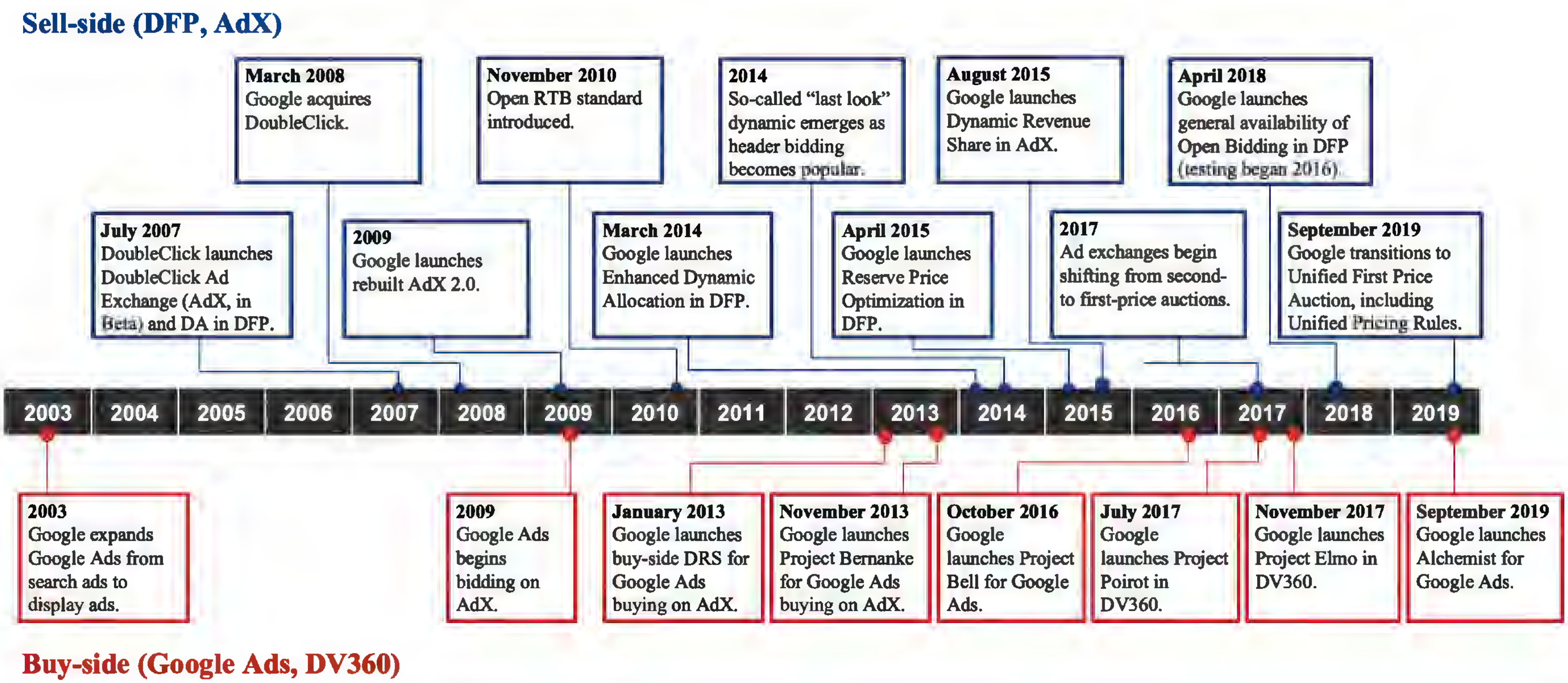
d. Plaintiffs' experts claim that publishers had "historically" set different floor prices for different demand sources in order to preference some exchanges and that UPR "removed a key tool used by publishers to maximize the yield on their inventory,"[20] but these claims are misleading because they overlook the historical context. As I explain in Section VIII and Section XIV in this report, for publishers to maximize revenue under a sequential allocation process like the waterfall and DA, they needed to set floor prices that depend on each demand source's order in the waterfall, with later demand sources generally having lower floors. Because UPR was introduced together with the Unified First-Price Auction (UFPA), when

[19] For example, consider a buying tool that submitted a single bid into the AdX second-price auction on behalf of a group of advertisers, with that bid equal to the highest value reported by the advertisers in that group. If the buying tool charged its advertiser customers the clearing price of the auction, then that policy would lower each advertiser's expected payment for any bid submitted (compared to a counterfactual policy of submitting two bids equal to the values of their two highest-value advertisers) because the second bid submitted by the buying tool can only increase the clearing price of the auction and thus the price charged to the advertiser. Thus, the result of the one-bid policy is a reduction in the expected price paid for each possible bid, which creates an incentive for an advertiser to report higher bids to the buying tool (higher even than its value for the impression) to try to win additional impressions at lower average prices.

[20] Expert Report of P. Pathak (Jun. 7, 2024), at ¶¶ 157 ("Historically, publishers set higher reserve price floors for AdX to account for the perceived lower ad-quality of impressions served through AdX and increase diversity of demand sources."), 159 ("By eliminating publishers' ability to set differential price floors across exchanges, Google removed a key tool used by publishers to maximize the yield on their inventory and ensure acceptable quality advertisements were displayed on their web pages.").

the waterfall was replaced by a single auction, this motive for setting unequal floor prices was eliminated. The rest of this allegation, which suggests that UPR made it difficult for publishers to preference non-Google exchanges, is again misleading because publishers have better means of preferencing exchanges, including post-auction discounts, as discussed in Section XIV. UPR also served an important positive function: it reduced the harm to advertisers of price-fishing strategies that publishers might find to be individually profitable but that would raise costs for advertisers and undermine their trust in the marketplace.

Figure 1: Timeline of Google's Product Evolution



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2. Plaintiffs' Experts Ignore the Benefits from Google's Business Model that Balances the Interests of Advertisers and Publishers

21. Professor Pathak asserts that "[b]uyers and sellers in marketplaces have opposing interests"[21] and that "[b]ecause Google is involved with all […] entities, it has an inherent conflict of interest."[22] But this characterization of marketplaces in general and Google's business model in particular is incomplete and omits the economic benefits arising from integration.

22. A matching market does not create a zero-sum game: buyers and sellers in matching marketplaces have a mix of aligned and conflicting interests. When a buyer's value for an impression exceeds the value of a seller's cost, *both* parties can benefit from the sale of the impression. Both sides can benefit when a well-designed marketplace improves match quality or facilitates more mutually beneficial transactions. Google, whose platform is paid based on trades between buyers and sellers, has an interest in growing the number and value of output-enhancing transactions on its platform.

23. Unlike an intermediary representing just one side of an industry, platforms like Google are incentivized to account for *externalities* that occur among participants on the platform. For example, where an intermediary representing sellers alone might be incentivized to engage in multi-calling (in which a publisher calls the same bidders

[21] Expert Report of P. Pathak (Jun. 7, 2024), at ¶ 17 ("Buyers and sellers in marketplaces have opposing interests. A buyer wishes to pay less for an impression, while a seller wants to receive more. The marketplace operator wishes to maximize trading volume and steer traffic to its exchange over competing alternatives.")

[22] Expert Report of P. Pathak (Jun. 7, 2024), at ¶ 17 ("Because Google is involved with all three entities, it has an inherent conflict of interest. Maximizing the interests of one type of participant may harm the interests of another type of participant. Google's conduct in the Ad Tech Stack results from conflicts of interest due to being involved in all sides of digital advertising transactions."). *See also* Expert Report of J. Chandler (Jun. 7, 2024), at ¶ 244 ("This consolidation of power presents potential conflicts of interest, particularly when a single entity oversees both the buy-side and sell-side platforms, as well as the exchange where transactions occur.").

multiple times to bid for an impression, possibly with different floor prices, harming both advertisers and other publishers and undermining the auction design), a platform representing *both* publishers and advertisers would account for the harms of such behavior on advertisers and would disincentivize that behavior. Professor Pathak contends that various elements of Google's challenged conduct would not have arisen but for Google's integrated business model.[23] But those claims overlook the fact that, for all of the programs that Plaintiffs and their experts claim to be anticompetitive, there are less integrated display advertising intermediaries with the same or similar features: see Table 1 below. This means that the challenged conduct cannot be explained solely as a result of Google's integration, as Professor Pathak contends.

24. While Professor Pathak's observation of conflicting incentives between buyers and sellers is exaggerated, it is true that buyers and sellers have conflicting interests regarding *prices*, which determine how any gains from each transaction are shared. But Google's business model balances those conflicting interests in a disciplined way that jointly benefits all participants on the platform. From its *publishers*, Google collects a contractually-determined average share of revenue that results from its auctions, and for its Google Ads advertisers, it charges *threshold prices*, that is, an advertiser pays the minimum bid required for it to win an impression given the Google Ads bidding policy. Together, these two policies determine the payments made to publishers and by

[23] *See, e.g.*, Expert Report of P. Pathak (Jun. 7, 2024), at ¶¶ 96 ("Google acts on its conflicts of interest by taking actions that are contrary to the principles of market design I outlined above which give rise to well-functioning marketplaces."), 135 ("Dynamic Allocation was motivated by Google's conflict of interest to use its ad server in service of its exchange."), 141 ("Google's initiatives to undermine Header Bidding reduced marketplace efficiency by skewing the allocations of impressions to favor AdX through Exchange Bidding and reducing the ability of other exchanges to compete in real-time. Absent the conflicts of interest arising from Google's suite of display advertising products, DFP would have no incentive to undermine a technology that would maximize value for its publisher customers."), 158 ("UPR is also motived by Google's conflict of interest to use the DFP ad server to give preferential access to the AdX exchange.").

advertisers. Taking those pricing policies as given, Google offers tools to help advertisers and publishers optimize their returns from display advertising. The only remaining decisions that affect the platform's prices are ones that determine how Google collects its revenue share from advertisers and publishers. Those decisions also affect the *matching* between advertisers and publishers and thus the total value created by the platform. The net result is that Google is incentivized to optimize the total value of the matches on its platform, including via innovations that improve matching, such as DA, EDA and Open Bidding.

Table 1: Google's Competitors Developed Similar Product Features as Challenged Google Products

Feature	Challenged Google Product	Competitor(s) with a Similar Product Feature	Report Section
Buy-side: Bid Optimization Programs Varying Revenue Shares	Buy-side DRS, Bernanke, Alchemist	[redacted]	IV
Buy-side: Adjusting Bids for Multi-calling	Bell, Elmo	The Trade Desk (TTD); MediaMath (before 2023); [redacted]	V, VI
Buy-side: Adjusting Bids for Bid Duplication	Elmo	[redacted]	VI
Buy-side: Adjusting Bids to Auction Format	Poirot, Marple	[redacted]; The Trade Desk; MediaMath (before 2023); [redacted]	VII
Sell-side: Auctions with Floors Determined by Remnant Line Items	Dynamic Allocation	OpenX; [redacted]	VIII
Sell-side: Direct Competition of Guaranteed Contracts and Remnant	Enhanced Dynamic Allocation	[redacted] Magnite; Comcast's FreeWheel; OpenX; [redacted]	IX
Sell-side: Line Items Associated with Header Bidding Determining Auction Floors	So-called "Last Look"	Open X; [redacted]	X
Sell-side: Reserve Price Optimization	RPO	[redacted] Magnite (formerly Rubicon); [redacted]	XI
Sell-side: Varying Revenue Shares by Impression	Sell-Side DRS	[redacted]	XII
Sell-side: Requiring Uniform Reserve Prices by Demand Source	UPR	[redacted] Meta (code of conduct for partners); Xandr (best practices)	XIV

3. Plaintiffs' Experts' Analyses Underestimate the Importance of Incentives

25. Plaintiffs and their experts routinely underestimate or understate the ability of and incentives for advertisers and publishers to optimize their behavior when Google introduces or modifies its auction programs. It is my opinion that accounting for advertiser and publisher incentives to respond to auction programs is necessary to evaluate correctly the economic effects of these programs, and Plaintiffs' experts' analyses that fail to do so are unreliable.

26. In the subfield of economics known as Market Design, it is routine and necessary for academic papers that analyze the effects of marketplace rules, programs, and practices to pay careful attention to how incentives affect the behavior of marketplace participants.[24] As Professor Weinberg acknowledges, this canonical method of analysis is "commonly accepted by researchers and practitioners for the analysis of the market at hand, online display ads."[25] The same method is described and applied in academic work by three of the Plaintiffs' experts—Professors Weinberg, Pathak, and Gans[26]—but it has not been

[24] In the syllabus of my Stanford class on this subject, I explain that "'Market design' is the subfield of economics that studies how best to organize *decentralized* resource allocation systems taking especially careful account of how the rules of the system affect individual *incentives* and *choices*. 'Decentralized' means that the system relies sensitively on information sourced from individual participants." *See* Paul Milgrom, "Market Design" Syllabus, Stanford University (accessed Jan. 10, 2024), https://canvas.stanford.edu/courses/171062. Similarly, the course description of Professor Susan Athey's Stanford University course entitled "Topics in Market Design" announces that it "studies the design of organized markets, focusing on efficient organization and *the incentives created by market rules*. Applications include online auction markets […] ." *See* Susan Athey, "Economics 980: Topics in Market Design," Stanford University (accessed Sep. 27, 2023) (emphasis added), https://gsb-faculty.stanford.edu/susan-athey/economics-980-topics-market-design/. Professor Weinberg explains that he is an expert in the closely-related field of "Algorithmic Mechanism Design, which is the study of algorithms (such as ad auctions) that involve economic incentives (such as those of publishers, exchanges, ad buying tools, and advertisers)." *See* Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 4.

[25] Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 13.

[26] *See, e.g.*, Cai, Y., Daskalakis, C., & Weinberg, S. M. (2013). Understanding incentives: Mechanism design becomes algorithm design. In *2013 IEEE 54th Annual Symposium on Foundations of Computer Science* (pp. 618-627) ("*Mechanism design* is the problem of optimizing an objective subject to 'rational inputs.' The difference to *algorithm design* is that the inputs to the objective are not known, but are owned by rational agents who need to be provided incentives in order to share enough information about their inputs such that the desired objective can be

applied consistently across the analyses in their expert reports. For theoretical predictions, a common approach to studying incentives in economic analyses of auctions is to investigate *equilibrium* whenever that is possible. "Equilibrium" means that all agents choose actions to maximize their benefits of participating in the auction and that they make accurate forecasts about other agents' choices.[27]

27. Although accounting fully for incentives is the standard and indispensable benchmark for evaluating the effects of Google's auction-related programs on its customers, it can be useful to supplement that analysis with one that focuses on what happens over shorter periods of time, when self-interested participants have not yet fully identified the new incentives and learned how best to adjust their actions. To study those shorter-lasting effects, I also incorporate analyses that assume behavior continues unchanged for a period after Google introduces a new program.

28. It is my opinion that Plaintiffs' experts' analyses that omit participants' incentives are unreliable, falling short of ordinary professional standards. When Professor Weinberg characterizes floor price optimizations by publishers as applying only to publishers who are "sophisticated" or "clever," he offers neither evidence nor logic to justify his

optimized."); Kojima, F., & Pathak, P.A. (2009). Incentives and stability in large two-sided matching markets. *American Economic Review, 99*(3), 608-627 ("Under some regularity conditions, we show that the fraction of participants with incentives to misrepresent their preferences when others are truthful approaches zero as the market becomes large."); Gans, J.S., & Holden, R.T. (2022). Mechanism design approaches to blockchain consensus, National Bureau of Economic Research Working Paper No. w30189 ("The question we address in this paper is whether there are more efficient and more reliable ways to achieve truth in consensus by designing and encoding mechanisms. Mechanism design is the branch of economics that deals with creating incentives for self-interested agents with information not known to the designer to reveal that information truthfully and still be willing to participate in the relevant economic activity.").

[27] Bayes-Nash equilibrium is a standard solution concept of game theory. *See* Harsanyi, J.C. (1967). Games with incomplete information played by "Bayesian" players, I-III. Part I. The basic model. *Management Science*, *14*(3), 159-182; Fudenberg, D., & Tirole, J. (1991). *Game theory*. MIT Press, at 3, 11-14.

decidedly non-standard approach.[28] In reality, floor price adjustments require no more sophistication than is routine in economic decision-making. For example, just as someone selling a used car who has been offered $10,000 for the car by a dealership benefits by offering it for a private sale at a higher price (say $12,000), rather than at the same $10,000 price, a publisher who has been offered $3 for an impression by a header bidder benefits by offering it in its auction at a higher floor price, rather than at the same $3 price. No special sophistication is needed to understand that.

29. Similarly, advertisers and the intermediaries that represent them need no unusual sophistication to identify and respond to the incentives discussed in this report. For example, a bidder (on DV360, say) that bids higher than the floor price and observes that it is routinely being charged its bid by a non-Google exchange purporting to run a second-price auction needs only to look at that data to learn that the exchange was actually running a first-price auction and that it should shade its bid to avoid overpaying for impressions. Yet that bidder response is ignored by Professor Gans in the analysis supporting his conclusion that Project Poirot "reallocat[ed] revenue from rival exchanges to Google's own exchange"[29] Empirical evidence from online display advertising

[28] *See, e.g.*, Expert Report of M. Weinberg (Jun. 7, 2024), at ft. 159 ("If a sophisticated publisher instead cleverly sets Value CPMs as a function of header bids, then AdX might still infer information about the maximum header bid, and in particular certainly knows that the maximum header bid lies below its reserve."), ft. 165 ("The impact of Dynamic Allocation with sophisticated publishers who cleverly set Value CPMs is less clear-cut. On one hand, if sophisticated publishers only slightly inflate the Value CPM of the winning header bid, then the above conclusions continue to hold for exactly the same reasons. On the other hand, if sophisticated publishers significantly inflate the Value CPM of the winning header bid due to Dynamic Allocation and would not have set such an inflated reserve on AdX in absence of Dynamic Allocation, then the cost of this inflated reserve might outweigh the benefits highlighted above."), ft. 225 ("If a sophisticated publisher mildly inflates AdX's reserve specifically because of the Last Look advantage, or if advertisers bid similarly in these two cases, the same conclusions still qualitatively hold. If a sophisticated publisher drastically inflates AdX's reserve specifically because of the Last Look advantage, or advertisers drastically change their bids specifically due to AdX's Last Look advantage, the impact is less clear-cut and would require a complicated analysis weighing the benefits of Last Look versus the impact of an increased reserve and distinct bids.").

[29] Expert Report of J. Gans (Jun. 7, 2024), at ¶ 865.

auctions suggests that bidders *do* learn to respond to auction design changes over time, and eventually come to adopt nearly profit-maximizing strategies.[30]

30. That finding is no accident. Many advertisers contract with specialized intermediaries (such as advertising agencies) to perform similar optimizations for them,[31] and some advertisers and publishers even employ teams of engineers, economists, and marketing experts devoted to maximizing returns by finding all possible improvements in advertising yields. And even though advertisers and publishers do not in all cases perfectly optimize their returns from display advertising, it is common for them to conduct experiments and learn to adjust their bidding and/or floor pricing strategies, which tends to bring them closer over time to the equilibrium benchmark.

31. For many publishers and advertisers, there are vast sums of money at stake, and online display advertising makes up a significant fraction of their marketing revenue or spend. Moreover, the largest advertisers and publishers make up a significant fraction of the online display advertising industry, suggesting that the strategic sophistication of these agents is especially relevant to auction outcomes.[32] Academic research has often found

[30] *See, e.g.*, Goke, S., Weintraub, G. Y., Mastromonaco, R., & Seljan, S. (2022). Bidders' responses to auction format change in internet display advertising auctions. Available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4021221.

[31] *See, e.g.*, [redacted]

[32] For example, in 2022, more than [redacted]% of Google Ads' US web spending across AdX, AdSense, and non-Google exchanges was by advertisers spending more than [redacted] on the platform. For the same criteria, more than [redacted]% of DV360 spending was by advertisers spending more than [redacted]. *See* GOOG-AT-MDL-DATA-000486626 to

that bidders with large stakes in auctions typically behave in line with their incentives, as predicted by equilibrium analysis.[33]

4. Plaintiffs' Experts' Analyses Underestimate the Role of Experimentation for Optimizing Returns

32. Plaintiffs and their experts claim that the optimization process for publishers and advertisers was compromised because "Google did not disclose their secret programs."[34] Plaintiffs' experts suggest that this alleged failure to disclose would mislead a "typical" advertiser or publisher, keeping it from optimizing its choices effectively.[35] In reality, processes for setting reserve prices and determining bids in auctions are routinely kept secret to prevent other auction participants from gaming these strategic choices. And

-8277 (Google Ads); GOOG-AT-MDL-DATA-000561263 to -420 (XBridge DV360). This result was generated using code/web_spend.py in my supporting materials, and the output is saved in code/logs/web_spend.txt.

[33] *See, e.g.*, Doraszelski, U., Lewis, G., & Pakes, A. (2018). Just starting out: Learning and equilibrium in a new market. *American Economic Review*, *108*(3), 565-615; Hortaçsu, A., & Puller, S. L. (2008). Understanding strategic bidding in multi‐unit auctions: A case study of the Texas electricity spot market. *The RAND Journal of Economics*, *39*(1), 86-114; Hortaçsu, A., Luco, F., Puller, S. L., & Zhu, D. (2019). Does strategic ability affect efficiency? Evidence from electricity markets. *American Economic Review*, *109*(12), 4302-4342.

[34] Expert Report of P. Pathak (Jun. 7, 2024), at ¶ 197 ("Finally, Google decreased transparency by deceptively changing auction rules and bidding rules, as I discuss in Section XII. Google did not disclose their secret programs. Had publishers and advertisers known about these programs, they would have the opportunity to adjust their behavior."). *See also* Fourth Amended Complaint ¶ 328 ("Google continued to mislead publishers and advertisers about the program and withheld critical information that the parties could have used to make an informed decision about the program."); Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 250 ("Moreover, all publishers likely would have changed their behavior if they knew about Projects Bernanke and Global Bernanke by raising their reserve prices.").

[35] *See, e.g.*, Expert Report of M. Weinberg (Jun. 7, 2024), at ft. 114 ("On one end, a 'typical' publisher may set parameters according to their ad server's suggested text without developing a detailed understanding of how those parameters are used. At the other end, a 'sophisticated' publisher may fully digest all available documentation and aim to optimize parameters based on their use case, ignoring suggested text. They may even be able to optimize while accounting for the possibility of conduct that is never disclosed in publicly available documentation. […] On one end, a 'typical' advertiser may trust their ad buying tool to optimize on their behalf and input correct information whenever requested (i.e., a 'typical' advertiser would simply input their correct value for an impression when asked). At the other end, a 'sophisticated' advertiser may fully digest all available documentation and aim to optimize inputs to their ad buying tool based on how these inputs are used, ignoring the ad buying tool's recommendations. They may even be able to optimize while accounting for the possibility of conduct that is never disclosed in publicly available documentation.").

even for those programs for which details are not disclosed at all, advertisers' and publishers' routine data analysis and experimentation with bids and floor prices are typically sufficient for them to identify optimal strategies. In practice, evidence suggests that ad tech intermediaries, in-house marketing teams, ad agencies, and publishers rely heavily on feedback and experimentation to optimize their performance:

a. *Advertisers* leverage key performance indicators to guide their campaign strategies on buy-side tools and bid effectively. Rather than calculating bids themselves, advertisers delegate many of the details of bid optimization to specialized buy-side tools[36] or agencies,[37] while optimizing their campaign parameters to achieve higher click-through rates, conversion rates, or return on ad spend. [redacted]

[36] For instance, [redacted]; Jenna Naylon, "Media Planning and Buying Strategies: The Importance of Test & Learn," MatrixPoint (accessed Jul. 17, 2024), https://www.thematrixpoint.com/resources/articles/media-planning-and-buying-strategies-the-importance-of-test-learn ("Applying a systematic approach to 'testing' (running controlled 'what ifs') varying aspects of media campaigns and 'learning' from the results to refine strategies, drive better results, and maximize marketing ROI. The core principle is to iterate and optimize based on data and insights gathered from continuous testing. Successful test and learn strategies include setting clear objectives, selecting appropriate key performance indicators (KPIs), allocating resources effectively, conducting A/B testing or multivariate testing, and implementing robust measurement and analysis procedures.").

[37] Both large and small advertisers consult with specialized agencies to achieve further sophistication. *See, e.g.*, [redacted]

[redacted][38] [redacted]”[39]

b. *Buy-side tools* depend on considerable experimentation, employing various learning algorithms to optimize bids on behalf of advertisers. Through experimentation, these algorithms can automatically and almost immediately adapt to changes in the environment. For example, an internal Google document found that certain buyers adjusted their bids in response to RPO, with the author noting, “[f]or RPO, some buyers are changing their bids […] some bid higher, some bid lower.”[40] Similarly, documents suggest that Criteo detected experiments related to DRS through Criteo’s own experiments that it ran for the purposes of bid optimization.[41]

[38] [redacted]

[39] [redacted]

[40] *See* “Display Ads Research Meeting Notes” (Jun. 19, 2017), GOOG-TEX-00831373, at -378. *See also* “AdX Managed Reserves” (Feb. 10, 2017), GOOG-DOJ-03643284, at -287 (“We also have evidence of third-party buyers bidding lower when we send RPO reserves.”).

[41] Email from [redacted] “Re: [criteo] Dynamic Pricing on eBay UK” (Feb. 2016), GOOG-DOJ-15426012, at -018, (“[Cr[redacted]ur team has found data suggesting that there is dynamic pricing on eBay in the UK. It looks like dynamic pricing starts from PMP [private market place] floors and follows a (floor+bid)/2 line.”).

c. *Publishers* frequently experiment to decide floor prices. A [redacted] There are supply-side intermediaries who assist in this process, as well, including Clickio, which offers floor price optimization tools and other services for publishers to "guarantee maximum revenues."[44]

33. Furthermore, Google's tools make such experimentation easier for its customers. For advertisers using Google Ads, an "Experiments" feature allows advertisers to conduct A/B tests on different campaign settings, including bidding strategies.[45] Advertisers using DV360 can use the "Insights" feature to conduct A/B tests on campaigns.[46] Google Ad Manager also contains functionality allowing publishers to experiment with various aspects of their properties, including floor prices, header bidding, and blocking.[47] Nor is

[42] [redacted]

[43] [redacted]

[44] Clickio, "Monetization" (accessed Jul. 7, 2024), https://clickio.com/monetization/ ("Automated price floor optimization can boost earnings by 20-120%, while also reducing the number of ads on a page, leading to a better user experience.").

[45] *See* Google, "Test Campaigns with Ease with Ads Experiments," Google Ads (accessed Jun. 26, 2024), https://ads.google.com/intl/en_us/home/tools/experiments.

[46] Luke Hedrick, "Get actionable measurement with Display & Video 360's Insights module," Google Marketing Platform (Nov. 15, 2018), https://blog.google/products/marketingplatform/360/get-actionable-measurement-display-video-360s-insights-module/.

[47] Google, "Run a manual experiment," Google Ad Manager Help (accessed Jun. 26, 2024), https://support.google.com/admanager/answer/9799933?hl=en#zippy=%2Cuser-messages%2Cnative-ad-style%2Cunified-pricing-rules%2Cyield-groups%2Cheader-bidding-trafficking-for-prebid.

Google alone in offering such tools: other advertising intermediaries also offer experimentation tools for their advertiser and publisher customers.[48]

34. By ignoring the evidence that publishers and advertisers experiment to optimize their returns from display advertising, Plaintiffs and their experts necessarily *underestimate* the amounts that Google's customers can earn from these programs. Across the wide range of programs I study in this report, I show that correcting this failure by Plaintiffs reveals significant benefits for advertisers and publishers from Google's auction features.

[48] *See, e.g.*, Microsoft, "Discover the possibilities with experiments," Microsoft Advertising (accessed Jun. 26, 2024), https://help.ads.microsoft.com/apex/index/3/en/56908; Magnite Team, "Magnite Unveils New Demand Manager Feature Powered by Machine Learning to Help Publishers Earn Incremental Revenue" (Oct. 5, 2023), Magnite, https://www.magnite.com/press/magnite-unveils-demand-manager-machine-learning-feature/; The Trade Desk, "Conversion Lift: What it is, how it works, and best practices" (Aug. 23, 2023), https://www.thetradedesk.com/us/resource-desk/best-practices-for-better-conversion-lift.

III. BACKGROUND AND ECONOMIC FRAMEWORK

A. The Key Economic Features of Online Display Advertising

35. Marketplaces are meeting places for trade. Buyers with wants and needs meet sellers of goods or services that can fulfill those wants and needs. When a buyer's value for a good or service exceeds a seller's cost, *both* parties can benefit from trade. Marketplaces provide social value when they facilitate additional opportunities for mutually profitable trade among economic agents.

36. In online display advertising, the key participants include website **publishers**, who sell ads on their websites (also known as **impressions**);[49] the **advertisers**, who buy impressions; and the **end users**, who may view and/or interact with the ads. Publishers use advertising sales to fund their production of internet content, which is often free or subsidized for end users. Advertisers can have many and diverse goals for their advertising campaigns, but they generally seek to increase the probability that an end user engages with their product, service, or message. End users experience benefits and costs from display ads: they may benefit directly from the information conveyed by the ad or indirectly from the ability to consume internet content at a reduced cost (*e.g.*, without facing a paywall), and they may experience costs in the form of the annoyance caused by unwanted advertisements or slower load times for web pages. In this report, because the

[49] In this report, I use the word "impression" to refer to an opportunity for a display advertisement that is offered for sale by a web publisher. This is a broader definition than the technical definition of impression typically used in the industry, which requires that the impression opportunity is successfully allocated to an advertiser and the associated advertisement loads successfully on the end user's browser. For example, Google Ads defines an impression as "[h]ow often your ad is shown[:] An impression is counted each time your ad is shown on a search result page or other site on the Google Network." Google, "Impressions: Definition," Google Ads Help (accessed Dec. 16, 2023), https://support.google.com/google-ads/answer/6320?hl=en.

costs and benefits to end users are difficult to measure and are not the main subject of Plaintiffs' allegations, I focus on the costs and benefits to publishers and advertisers.

37. Occasionally, I will refer to **economic welfare**, by which I will mean the total value to advertisers, minus any costs incurred by publishers and intermediaries. This definition of economic welfare is independent of the prices paid by advertisers for impressions and the fees charged by intermediaries, with these factors determining how economic welfare gets split among advertisers, publishers, and intermediaries.[50] A change in practices is said to **increase efficiency** if it increases economic welfare. For example, a change in matching procedures that leads to assigning impressions to advertisers with higher values increases efficiency and may benefit *both* publishers and advertisers.

38. One of the key challenges facing an advertiser is to identify the appropriate audience for its advertising campaign. The probability that any single ad successfully influences the end user (for example, to click on the ad, buy a product, sign up to an email list, or vote for a political candidate) is typically low.[51] At the same time, the potential benefits to the advertiser from a successful interaction, called a **conversion**, can be significant.

39. In economics parlance, online display advertising is a **matching market** because the value of an impression to an advertiser typically depends on various factors, including the ad shown, the identity of the end user, and the context of the ad. Advertisers are willing

[50] Economic welfare can equivalently be defined as the sum of the advertiser surplus earned by advertisers (see the definition of advertiser surplus in Paragraph 53 below), plus the profits earned by publishers, plus the profits earned by any intermediaries.

[51] For example, according to the Google Ad Manager Log-Level Dataset (January 2024), GOOG-AT-EDTX-DATA-000276098 to -001116097, about [redacted]% of US impressions won by bidders with transaction types "Open Bidding" or "Open Auction" resulted in a click. This result was generated using [redacted] in my supporting materials, and the output is saved in [redacted]

to pay more to show their ads to end users for whom that ad is more likely to be more relevant. For instance, a restaurant in Dallas, Texas is unlikely to derive much value from advertising its specials to an end user in San Francisco, but may have a high value for advertising them to end users in Dallas, especially those who dine out frequently or have visited that restaurant in the past. The same restaurant might derive more benefit from an advertisement next to a restaurant review in The Dallas Morning News online than from an ad on the sports page. Other advertisers, such as Ticketmaster, might have the opposite preference. Improved matching that places higher value ads for each impression can increase both the price paid to publishers and the profits earned by advertisers.

40. Another key economic feature of online display advertising is that ad impressions on webpages are quickly **perishable**: they must be allocated within fractions of a second of the end user's arrival to maximize the chance that the ad will be noticed. The perishability of impression opportunities distinguishes the matching problem in online display advertising from that faced on other online matching platforms (*e.g.*, real estate platforms like Zillow or dating websites like eHarmony) in which there is typically much more time for counterparties to consider and finalize the details of their matches.

41. These two characteristics—that good matching is key to creating value and that impressions are perishable—distinguish online display advertising platforms from commodity exchanges and from trading platforms for securities like stocks and bonds. In the sale of securities, buyers and sellers often care little about the identity of their trading partners. Partly as a result of that, trading platforms for securities are most often anonymous. In addition, securities are less perishable, with investors sometimes postponing their trading for days or longer if they are unsatisfied with current prices.

B. Intermediation in Online Display Advertising

1. How Intermediation Can Improve Matching

42. The challenges associated with matching impressions to end users encourage **intermediaries** to offer increasingly effective services. These services may increase economic welfare by allowing advertisers and publishers to quickly identify more and better matches and/or reducing the costs of participation (sometimes called **market frictions** or **transaction costs**). Such intermediaries typically share in the benefits of increased economic welfare by charging fees for their services.

43. Common approaches taken by intermediaries that increase economic welfare include:[52]

   a. *Making it easier for publishers and advertisers to transact:* Intermediaries can make participation easier by performing technical and strategic computations that help publishers to manage their inventories or advertisers to evaluate and bid on millions of impressions. Without such intermediation, each buyer and seller might incur the costs of developing processes, performing computations, and making the inevitable errors that result from the complexity and frequent changes of an industry that is evolving and growing. In my own auction consulting in this industry and others, I have emphasized the importance of making bidding easier to encourage participation and promote value creation.[53]

[52] *See, e.g.*, Roth, A.E. (2015). *Who gets what—and why: The new economics of matchmaking and market design*. Houghton Mifflin Harcourt, at 8-11.

[53] For example, in my published advice as consultant to the US Federal Communications Commission, I wrote that "the auction process needs to be simple and easy enough to encourage and facilitate the participation of a wide array of broadcasters […] [and] make it very easy for broadcasters to make optimal bids." Auctionomics and Power Auctions, "Incentive Auction Rules Option and Discussion," FCC (Sep. 12, 2012), https://docs.fcc.gov/public/attachments/FCC-12-118A2.pdf, at 2.

b. *Making participation safer:* Intermediaries often design and enforce rules to protect participants from being taken advantage of by other participants on the platform. A lack of safety can force participants to spend resources monitoring and strategizing to protect against unscrupulous behavior. Such expenses can be wasteful and discourage participation.

c. *Making the platform thicker:* Matching platforms work better when they are *thicker*, which for online ad platforms means more advertisers, more impressions, and better information.[54] Thicker matching platforms enable advertisers to find more suitable impressions and to spend their budgets more effectively. They may also enable publishers to attract more bidders and higher prices for their impressions. In these ways, thicker matching platforms improve economic welfare. For online advertising, intermediaries can promote thickness and create more valuable matches by exposing each bidder to a larger number of relevant impressions or providing the information that bidders need to evaluate those impressions.

[54] I note that this definition of thickness does not explicitly include the number of publishers. In online display advertising, the value of an advertisement is primarily driven by the match between an advertiser and an end user, so the most relevant measure of thickness is of advertisers and the number of impressions, not the number of publishers. Even a single publisher can have many end users and many impressions (*e.g.*, Facebook), so a platform matching many advertisers to a single publisher's impressions could also be thick. Academic research studying online advertising often define thickness by the number of advertisers competing per impression. *See, e.g.*, Levin, J., & Milgrom, P. (2010). Online advertising: Heterogeneity and conflation in market design. *American Economic Review: Papers & Proceedings*, *100*(2), 603-07, at 607; Ye, Z., Zhang, D.J., Zhang, H., Zhang, R., Chen, X., & Xu, Z. (2023). Cold start to improve market thickness on online advertising platforms: Data-driven algorithms and field experiments. *Management Science*, *69*(7), 3838-60, at 3839 ("Throughout this paper, we use the market thickness to represent the average number of ads competing for user impressions on an online advertising platform."); D'Annunzio, A., & Russo, A. (2024). Intermediaries in the online advertising market. *Marketing Science*, *43*(1), 33-53, at 34 ("Advertising markets differ in their thickness (*i.e.*, the number of advertisers belonging to that market)").

d. *Making processes more efficient:* Fixing the set of participants and the information they receive, intermediaries can increase economic welfare by adopting technologies that enable more offers to be directly compared, so that the allocation process can assign each impression to the participating advertiser who values it most highly.

e. *Reducing latency:* Intermediaries can reduce transaction costs by eliminating unnecessary and duplicative steps and increasing the speed at which transaction opportunities are identified and processed. This reduces the likelihood that an end user leaves the website before the ad is presented.

44. The perishability of impressions creates special challenges for intermediaries in online display advertising beyond those faced on other matching platforms. Matching platforms in other industries often help buyers and sellers identify potential matches but leave it to the parties themselves to finalize the details of their transactions (as on, for example, real estate platforms like Zillow, hotel booking platforms like Booking.com, or dating platforms like eHarmony). In contrast, online display advertising intermediaries typically need to automate the entire transaction to allow ads to be shown almost immediately. The advent of **programmatic advertising** was a response to this challenge, in which intermediaries create automated systems to analyze data, compare options, and make decisions to buy or sell impressions for publishers and advertisers, all in a few hundred milliseconds.

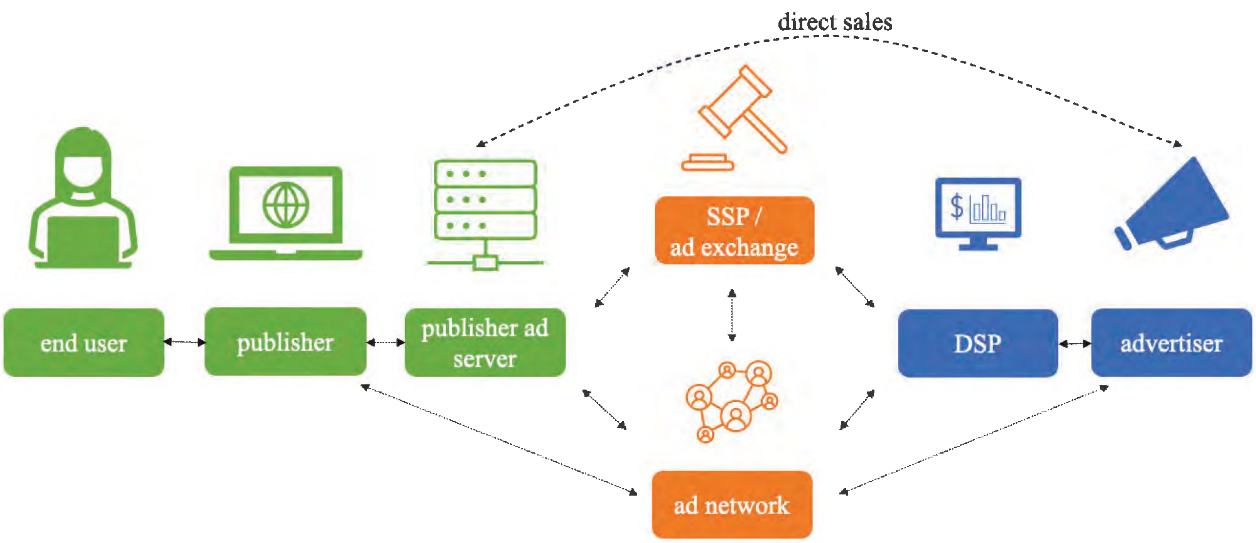
2. The Ad Tech "Stack"

45. To illustrate the various roles of online display advertising intermediaries, consider the following simplified depiction of one of the pathways in the programmatic advertising supply chain. First, an **end user** arrives at a publisher's website, which has an impression opportunity available to be filled by an ad. While the webpage is loading, a **call** can be made to the **publisher's ad server**, which is an intermediary that helps publishers manage their online display advertising inventory. The publisher's ad server may make an initial decision about the allocation of the impression, based on parameters chosen by the publisher. In some cases, the server might allocate the impression directly to an advertiser who has a pre-arranged contract with the publisher. In other cases, the publisher's ad server might make a call to one or more **ad exchanges** or **supply-side platforms (SSPs)**, which allow publishers to sell inventory using programmatic sales mechanisms, including auctions. These auctions typically involve calls to **demand-side platforms (DSPs)**, which are intermediaries that help advertisers purchase online display advertising inventory.[55] The publisher's ad server or the ad exchange might also make a call to one or more **ad networks**, which buy online display advertising inventory directly from publishers or through other intermediaries on behalf of advertisers in their networks. After the winning advertiser is determined, the advertising content is transmitted to the end user's browser by the **advertiser's ad server**, which is an intermediary that manages and stores advertisers' ads. This entire process is completed within a fraction of a second after the arrival of the end user at the publisher's webpage.

[55] I use the terms "buying tool," "buy-side tool," and "DSP" interchangeably in this report.

46. Collectively, these intermediaries are sometimes referred to as the **ad tech stack**, depicted graphically in Figure 2.

Figure 2: Simplified Depiction of the Ad Tech Stack



47. I emphasize that the above is a *simplified* description of the allocation process for *some* online display advertising impressions. Different publishers and supply-side platforms may use allocation processes different from the ones I described above, and advertisers may reach end users through different pathways. Advertising technology has evolved considerably over the past two decades and continues to evolve. Other important intermediaries, which may participate in the ad tech stack but are not included in my simplified description above, include **ad agencies**, which assist advertisers in planning and designing their advertising campaigns, and other intermediaries that assist advertisers and publishers, manage payments, and track user engagement. This description also omits **header bidding**, a technology that allows publishers to call demand sources directly, without first calling a publisher ad server. I discuss header bidding in detail in Sections X and XIII.

48. Another significant function of online display advertising intermediaries is the collection and management of data used by advertisers to identify end users and assess their values for display advertising inventory. One of the key tools used in this process is the **cookie**, which is a small text file stored in an end user's browser.[56] Cookies come in two main varieties: **first-party cookies**, allowing publishers to track user behavior on their own websites, and **third-party cookies**, allowing intermediaries to track user behavior *across* websites.[57] When a user first loads a website including content from an online display advertising intermediary, a third-party cookie is stored in the user's browser. After that time (or until that cookie is deleted in the end user's browser), the display advertising intermediary can track that user's activity across different websites that also include any content from that intermediary.[58] This allows the intermediary to develop a profile of an end user based on his/her browsing behavior, which can help advertisers assess the value of impressions associated with that cookie.[59] Because different display advertising intermediaries have different cookie information about end users, a process called **cookie**

[56] [redacted] (Redacted) (Sep. 29, 2023), GOOG-AT-MDL-C-000016753, at ¶ 14 ("In general, cookies are small data files stored on a web browser that can serve different functions.").

[57] Maciej Zawadziński & Mike Sweeney, "What is cookie syncing and how does it work?," Clearcode Blog (Jan. 31, 2024), https://clearcode.cc/blog/cookie-syncing/ ("Different Types of Cookies [...] First-party cookies are created by the websites we visit directly. [...] Third-party cookies, also referred to as tracking cookies, are collected not by the website, but by advertisers.").

[58] Maciej Zawadziński & Mike Sweeney, "What is cookie syncing and how does it work?," Clearcode Blog (Jan. 31, 2024), https://clearcode.cc/blog/cookie-syncing/ ("Third-party trackers can also track a user's behavior, such as the content they view on that website and the things they click on (e.g. products and ads). The trackers create third-party cookies and use them to display adverts to the user when they visit different websites. [...] Each time a user visits a website that contains ads (or third-party tracking tags), the browser sends an ad request to an advertising technology platform (e.g. a DSP).").

[59] *See, e.g.*, [redacted] (Redacted) (Sep. 29, 2023), GOOG-AT-MDL-C-000016753, at ¶¶ 16 ("[Cookie matching] allows an RTB participant, for example, to limit the bid requests they receive to those involving users that they previously interacted with, as determined by the presence of their cookies."), 39 ("Broadly speaking, these settings and controls will determine [...] whether cookies or other pseudonymous identifiers can be included (where they are available) which enables RTB participants to select ads based on information they may have on prior activity associated with the identifier.").

matching (or cookie syncing) is sometimes used to match (often imperfectly) cookies collected by one advertising intermediary to those collected by another, with this process aided by additional intermediaries, called **data management platforms**.[60] Google offers a cookie matching service to allow bidders in its display advertising auctions to match their cookies with Google's proprietary cookies, called Biscotti.[61] Advertisers often supplement data collected via third-party cookies with other first-party information about the end user to determine their value for displaying an ad.[62]

C. Information, Incentives, and Auctions

1. Auctions Aggregate Dispersed Information

49. One of the challenges associated with efficient matching and intermediation in online display advertising is that information about the value of an impression to different advertisers is typically dispersed and not directly observed by all advertisers, publishers, and intermediaries. An advertiser does not typically have all the information required to assess its value for showing an ad to the end user and needs to rely on information collected by publishers and intermediaries about the user's characteristics and browsing behavior. Meanwhile, a publisher seeking to sell online display advertising inventory

[60] Maciej Zawadziński & Mike Sweeney, "What is cookie syncing and how does it work?," Clearcode Blog (Jan. 31, 2024) https://clearcode.cc/blog/cookie-syncing/ ("An example of this would be mapping a user's ID from a demand-side platform (DSP) to a data management platform (DMP). This process is known as cookie syncing. [...] Cookie syncing works when two different advertising systems (aka platforms) map each other's unique IDs and subsequently share information that they have both gathered about the same user.").

[61] [redacted] (Redacted) [redacted], GOOG-AT-MDL-C-000016753, at ¶ 16 ("RTB participants may utilize their own cookies, in the same way Google uses a Biscotti. 'Cookie matching' allows RTB participants to match their cookies with Google's Biscotti for the same browser.").

[62] *See* [redacted] (Redacted) [redacted], GOOG-AT-MDL-C-000016753, at ¶ 39 ("Broadly speaking, these settings and controls will determine [...] whether cookies or other pseudonymous identifiers can be included (where they are available) which enables RTB participants to select ads based on information they may have on prior activity associated with the identifier.").

typically does not know the value of each impression to each potential buyer, or even the identities of all the potential buyers for a given impression. If advertisers and publishers had all of that information, auctions and many other services offered by intermediaries would be unnecessary because the publisher could simply sell each impression to the highest-value advertiser at a mutually agreeable price. Information processing is key to effective matching and pricing.

50. Auctions can perform a central role in this process: the auctioneer *distributes* certain information about the item being sold and receives information in the form of **bids** and uses those to allocate the item and determine payments. In this report, I focus on **sealed-bid auctions**, which are auctions in which bidders report their bids to the system just once at the start of each auction.[63] Because they can be resolved so quickly, sealed-bid auctions work well for online display advertising sales, where impressions are rapidly perishable.

51. In most auctions for a single item, the **winning bidder** is the bidder with the highest bid and only that bidder makes a payment to the auctioneer. The amount it pays to the auctioneer is called the auction's **clearing price**. Many auctions incorporate a **floor price** (also known as a **reserve price**), which is a price below which the seller is unwilling to sell. In an auction with a floor price, only bids that exceed the floor price are considered.

52. Auctions are popular when different bidders might value an item differently because they allow bidders' information about different goods to be reflected in prices, a process called

[63] Other types of auctions may elicit information from the same bidder *multiple* times during the auction: for example, in "open outcry" English auctions (an auction format commonly used for art auctions at, say, Sotheby's), bidders may make multiple sequential bids for an item, each of which must be higher than the current highest bid, and the bidder who makes the final bid wins the auction at a price equal to its bid.

price discovery.[64] Sealed-bid auctions are particularly suitable for online display ad impressions because of their ability to discover prices and allocate items rapidly to bidders whose values may be quite different and changing over time.

2. *How Auction Designs Affect Publisher and Advertiser Incentives*

53. In much of this report, I assume that an advertiser's objective in an auction is its **advertiser surplus** (also known as **advertiser profit**), which is equal to the difference between its value for the impression if it wins it and the price it pays.[65] An advertiser chooses a bid to maximize the *expected* value of this advertiser surplus, given its prediction of the behavior of other bidders. A publisher's objective is its **revenue**, which is equal to the payment it receives for an impression. The publisher chooses its floor price in the auction, which is the minimum payment it is willing to accept for the impression (discussed further in Section III.C.3.d) to maximize its *expected* revenues, given its predictions of the behavior of bidders.[66] If each agent chooses actions to maximize its benefits of participating in the auction, assuming that all other agents also maximize their returns, and if agents' forecasts of others' choices are statistically accurate, then their

[64] *See, e.g.*, Milgrom, P. (2017). *Discovering prices: auction design in markets with complex constraints*. Columbia University Press, at 46 ("Even when prices to guide efficient resource allocation exist in theory, the practical problem of finding those prices can still be daunting. […] The best way to find such prices is often an auction of some kind.").

[65] Advertisers may have other campaign objectives, but as I discuss in Section VII.C, *any* rational strategy for an advertiser (*i.e.*, any strategy that purchases a set of impressions in the *least-cost* way) leads to choosing bids for each individual impression that maximize expected advertiser surplus given some value for the impression.

[66] Publishers and advertisers may make decisions other than floor prices and bids, including where to sell or bid for an impression and how many impressions to offer. Where these other decisions are relevant to my analysis, I also assume that publishers and advertisers make these decisions in line with their incentives.

choices are said to be in **(Bayes-Nash) equilibrium**.[67] Equilibrium analysis is a common basis of theoretical predictions about auctions because it accounts for the incentives of all participants.

54. In much of this report, I adopt the common approach of assuming that advertisers and publishers respond to the rules and conditions they face to maximize their individual returns from online display advertising. There are several reasons that I believe this to be the relevant standard for this case.

55. *First*, there are vast sums of money at stake for many of the publishers and advertisers in the industry. Many also have large teams of engineers, economists, and marketing experts devoted to maximizing returns by finding all possible improvements in advertising yields. The largest advertisers and publishers also make up a significant fraction of the online display advertising industry, suggesting that the strategic sophistication of these agents is especially relevant to auction outcomes.[68] Academic research has found that bidders with large stakes in auctions typically behave in line with their incentives, as predicted by equilibrium analysis.[69]

[67] Bayes-Nash equilibrium is a standard solution concept of game theory. *See* Harsanyi, J. C. (1967). Games with incomplete information played by "Bayesian" players, I-III. Part I. The basic model. *Management Science*, *14*(3), 159-182; Fudenberg, D., & Tirole, J. (1991). *Game theory*. MIT Press, at 3, 11-14.

[68] For example, in 2022, more than [redacted]% of Google Ads' US web spending across AdX, AdSense, and non-Google exchanges was by advertisers spending more than $100,000 on the platform. For the same criteria, more than [redacted]% of DV360 spending was by advertisers spending more than $100,000. *See* GOOG-AT-MDL-DATA-000486626 to -8277 (Google Ads); GOOG-AT-MDL-DATA-000561263 to -420 (XBridge DV360). This result was generated using [redacted] in my supporting materials, and the output is saved in [redacted]

[69] *See, e.g.*, Doraszelski, U., Lewis, G., & Pakes, A. (2018). Just starting out: Learning and equilibrium in a new market. *American Economic Review*, *108*(3), 565-615; Hortaçsu, A., & Puller, S. L. (2008). Understanding strategic bidding in multi-unit auctions: A case study of the Texas electricity spot market. *The RAND Journal of Economics*, *39*(1), 86-114; Hortaçsu, A., Luco, F., Puller, S. L., & Zhu, D. (2019). Does strategic ability affect efficiency? Evidence from electricity markets. *American Economic Review*, *109*(12), 4302-4342.

56. *Second*, publishers and bidders in online display advertising typically participate in many auctions, with this repeated interaction creating opportunities to experiment, learn, and improve strategies over time. Empirical evidence from online display advertising auctions suggests that agents learn to respond to auction design changes over time, and eventually come to adopt near-profit-maximizing strategies.[70] This research suggests that strategic adaptation is not always immediate and that there is heterogeneity in the speed of learning, which implies that evidence about the impact of new programs gathered over short periods of experimentation must be evaluated with care: it may fail to capture eventual strategic adaptations and heterogeneity in effects over time and across agents.

57. *Third*, intermediaries that serve publishers and advertisers compete for business by offering optimization tools, so that even smaller advertisers and publishers have access to sophisticated tools to optimize performance. The *stated* objective of many tools therefore offers a window into what they believe their customers—publishers and advertisers—may want. These statements clearly support the hypothesis that publishers and advertisers seek to optimize returns.

58. Here are some examples. On the supply-side, Microsoft's Xandr offers "yield optimization tools to maximize the value of […] inventory."[71] Pubmatic offers tools to "maximize advertising revenue."[72] Criteo's Commerce Grid SSP gives "media owners the

[70] *See, e.g.*, Goke, S., Weintraub, G. Y., Mastromonaco, R., & Seljan, S. (2022). Bidders' responses to auction format change in internet display advertising auctions. Available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4021221.

[71] Xandr, "Publisher Platforms," Microsoft Advertising (accessed Oct. 25, 2023), https://about.ads.microsoft.com/en-us/solutions/xandr/publisher-platforms-scaled-buying-selling-solutions.

[72] Pubmatic, "Pubmatic SSP: Maximize Advertising Revenue and Control How Your Audiences are Accessed," Pubmatic (accessed Oct. 25, 2023), https://pubmatic.com/products/pubmatic-ssp-for-publishers/.

control to optimize the monetization of their inventory."[73] Google Ad Manager offers "yield management solutions" including to "[m]aximize revenue in the unified first price auction."[74] Clickio offers floor price optimization tools and other services for publishers to "guarantee maximum revenues."[75] On the demand-side, The Trade Desk offers tools to advertisers to "[m]aximize [their] digital investment" by "[r]each[ing] the right audience and spend[ing] [their] budget more efficiently."[76] Xandr's DSP offers optimization tools to allow advertisers "to get the greatest benefit for the money spent on campaigns."[77] Criteo's smart bidding tool for its advertiser customers "ensures a bid placed for any display opportunity offers the highest yield for clients and publishers."[78] Google Ads offers "[t]ools to help [an advertiser] optimize […] bids" and help with "maximizing [its] Google Ads budget."[79] Google's Display & Video 360 (DV360) offers automation tools

[73] Criteo S.A., Form 10-K, United States Securities and Exchange Commission (2022), https://www.sec.gov/Archives/edgar/data/1576427/000157642723000023/crto-20221231.htm.

[74] Google, "Get comprehensive yield management with Google Ad Manager," Google Ad Manager (accessed Oct. 25, 2023), https://admanager.google.com/home/resources/feature-brief-yield-management/.

[75] Clickio, "Monetization" (accessed Jul. 7, 2024), https://clickio.com/monetization/.

[76] The Trade Desk, "DFP Features[:] Integrated planning and activation (accessed Oct. 31, 2023), https://www.thetradedesk.com/us/our-platform/dsp-demand-side-platform/plan-campaigns.

[77] Xandr, "Understanding Optimization," Xandr Documentation Center (Feb. 7, 2022), https://docs.xandr.com/bundle/monetize_monetize-standard/page/topics/understanding-optimization.html.

[78] Criteo, "What You Need to Know About First-Price Auctions and Criteo," Criteo Updates (Sep. 26, 2023), https://www.criteo.com/blog/first-price-auctions/.

[79] Google, "Evaluate and optimize your bids," Google Ads Help (accessed Oct. 31, 2023), https://support.google.com/google-ads/answer/7085711?hl=en; Google, "10 tips for Google Ads budget management," Google Ads Resources (Mar. 20, 2023), https://ads.google.com/intl/en_us/home/resources/articles/stretching-your-google-ads-budget/. *See also* Deposition of [redacted] at 370:6-8 (Sep. 17, 2021), GOOG-AT-MDL-007173084, at -454 ("The goal of predicted highest other bid is to optimize towards the advertiser's surplus."); Design Doc, "AdX/AdMob first price bidder - for perf" (Sep. 26, 2019), GOOG-DOJ-AT-00573492, at -495 ("Surplus maximization to determine the optimal bid: First-price bid is the one that maximizes the advertiser surplus = advertiser value - payout.").

to "help make optimal bids to help improve campaign performance."[80, 81] The stated objectives of these tools offered by intermediaries suggest that optimizing returns is a leading goal of advertisers and publishers and that their customers outsource many decisions to intermediaries to reduce the burden of understanding all the details of auction rules and optimizations themselves.

3. *Types of Sealed-Bid Auctions*

59. Auctions can use a variety of rules to determine allocations and payments. Different auction designs create different incentives for auction participants.

a) Second-Price Auctions and Threshold Pricing

60. A common auction practice early in the history of the online ad industry was the use of **second-price auctions**, in which the highest bidder for an impression wins and pays a price equal to the larger of the floor price or the second-highest bid. The second-price auction rule is the sealed-bid implementation of the well-known **ascending auction**,[82] in which the auctioneer asks for bids at the floor price and gradually increases the price until just one bidder remains. The winning bidder in an ascending auction pays a price that is determined by the drop-out price of the *second-to-last-remaining* bidder, just as the winning bidder in the second-price sealed-bid auction pays a price determined by the bid of the *second-highest* bidder.

[80] Google, "Enhanced automation," Display & Video 360 Help (accessed Oct. 31, 2023), https://support.google.com/displayvideo/answer/6130826?hl=en.

[81] The surplus-maximization objective of DV360 is also clearly captured in the design of Poirot, as discussed further in Section VII.

[82] *See* Vickrey, W. (1961). Counterspeculation, auctions, and competitive sealed tenders. *Journal of Finance*, *16*(1), 8-37.

61. The second-price auction is the canonical member of a class of auctions that uses **threshold pricing**, meaning that the price paid by the winning bidder does not depend on its winning bid but is instead the lowest amount (called the **threshold**) that the winning bidder could have bid to win the auction, holding all other bids fixed. Auctions with threshold pricing can vary in their winner-selection rules: the second-price auction is the auction using threshold pricing in which the highest bid always wins.[83] All auctions with threshold pricing have the following important property: once an advertiser has determined its value for an impression—the maximum price it is willing to pay for that impression—it can maximize its profit in the auction simply by bidding that value.[84, 85] An auction with this property is called **bidder-truthful** (or sometimes **incentive-compatible** or **strategy-proof** or **truthful**).

62. To see why it is always optimal with threshold pricing for the advertiser to bid its value, *v*, there are two cases to consider. First, suppose that the minimum bid needed to win the auction is some amount *x,* which is less than *v*. Then, bidding the advertiser's value *v* will win the auction and, by the threshold pricing rule, the winner will pay *x*. Any other bid either wins the auction at the same price or loses the auction (guaranteeing zero payoffs), so no other bid can do better: bidding *v* maximizes the bidder's surplus. Second, suppose

[83] As another example, a publisher's online ad auction might specify that some favored bidder wins an impression if its bid plus 25% is higher than any other bid; otherwise, the item goes to the highest other bidder. Using this rule to determine the winner results in the favored bidder, when it wins, paying a discounted threshold price. For example, if the highest bid from a regular customer is 100 and the favored bidder bids more than its threshold of 80, then it wins and pays a price of 80, even if its own bid was, say, 90.

[84] Milgrom, P., & Segal, I. (2020). Clock auctions and radio spectrum reallocation. *Journal of Political Economy*, *128*(1), 1-31, at 16-18 ("Proposition 3. Any threshold auction is strategy-proof. Conversely, any strategy-proof direct auction has a monotonic allocation rule, and if V=R^N_+, it must be a threshold auction.").

[85] Bidder-truthfulness applies to a single auction for an impression. When the same agents interact in multiple auctions, advertisers may have different incentives leading them not to bid their values. For example, an advertiser may not want to reveal that it has a high value for an impression if it anticipates that the publisher will change its floor price in subsequent auctions to take advantage of that information.

that the minimum bid to win the auction is some amount *y*, which is greater than *v*. Then, bidding the advertiser's value *v* will lose the auction, but any winning bid would require that the advertiser pay a price *y*, which is more than its value. So, in this second case, too, there is no bid that earns the advertiser more than bidding its value *v*.

63. Bidder-truthful auctions reduce bidding errors and the costs of bidding because they eliminate any need for an advertiser to assess who else might be bidding, how much they might bid, or the publisher's floor price. In non-bidder-truthful auctions, each advertiser's bid depends on all of these factors. I have previously advised auctioneers to adopt bidder-truthful auctions, highlighting the importance of easy bidding.[86]

64. Other auctions using threshold pricing besides the second-price auction were used in several of Google's programs, as described later in this report. Threshold pricing is special not just because it results in bidder-truthful auctions, but also because these are the *only* bidder-truthful auctions. There are no others.[87] Any auction in which a winning bidder pays something other than its threshold price is not bidder-truthful, and as a consequence, incentivizes bidders to choose bids that differ from their values for the good being sold.

[86] When the US Federal Communications Commission sought to repurchase certain television broadcast rights, I advised a bidder-truthful auction so that for any television broadcaster, "the hardest part of bidding will be to determine its value of continuing to broadcast. Once it knows that value, the rest is easy. The bidder cannot do better than to agree to accept any price greater than its value of continuing to broadcast and then to exit if its offered price falls lower than that. By bidding in this way, the station will obtain its best possible price[…]" Auctionomics and Power Auctions, "Incentive Auction Rules Option and Discussion," FCC (Sep. 12, 2012), https://docs.fcc.gov/public/attachments/FCC-12-118A2.pdf, at 3.

[87] For proof, notice that if the price paid by a winning bidder depends on its bid, then instead of bidding truthfully, a bidder prefers to make the winning bid that results in the lowest price. *See* Milgrom, P., & Segal, I. (2020). Clock auctions and radio spectrum reallocation. *Journal of Political Economy*, *128*(1), 1-31, at 16-18.

65. Google recognized the advantages of bidder-truthful auctions, explaining them as follows: "It's faster, less costly, and more fair to the less sophisticated advertisers to structure the auction in favor of true value."[88] The lower transaction costs associated with bidding in a bidder-truthful auction encourage advertisers to participate on Google's platform, which increases thickness, tending to improve the efficiency of its allocations and increase the prices paid to publishers.[89]

66. Second-price auctions have an additional important benefit: if bidders bid truthfully, then the price determined by the auction for each impression is a **market-clearing price**. A market-clearing price is one at which supply equals demand—one bidder is willing to pay the price and no losing bidder is willing to pay more. Whenever an impression is transacted at a market-clearing price, that transaction maximizes the economic welfare that can be created from the sale of the impression. It can be proved mathematically that the second-price auction is the only bidder-truthful auction that always transacts the impression at a market-clearing price.[90]

b) First-Price Auctions

67. In a first-price auction, the bidder with the highest bid wins and pays a price equal to its bid for the item (unless the highest bid is below the floor price, in which case the item is unallocated). In contrast to the second-price auction, *every* bidder in a first-price auction needs to **shade** its bid—that is, choose a bid *less* than its value—in order to stand any

[88] "GDN Auction Overview" (Oct. 11, 2014), GOOG-AT-MDL-001094067, at -085.

[89] *See, e.g.*, Vickrey, W. (1961). Counterspeculation, auctions, and competitive sealed tenders. *Journal of Finance*, *16*(1), 8-37.

[90] *See* Milgrom, P. (2004). *Putting auction theory to work*. Cambridge University Press, at 71-73.

chance of making a profit.[91] From a bidder's perspective, its optimal bid shading results from a tradeoff: a higher bid increases the probability of winning an impression, but it also increases the bidder's price for the impression if it wins. The optimal shading calculation depends on the bidder's estimates or guesses about what others might bid: the bidder should reduce its bid more if it expects lower bids from others. Guessing the identities and bids of others for each different impression is a costly and error-prone activity that can lead to inefficiency when bidders' guesses are wrong. In a first-price auction, the winner may be a bidder who does not have the highest value for the impression. Even when the impression is allocated correctly, the winning bid may not be a market-clearing price: after seeing the outcome, some losing bidders may have been willing to pay more than the winning bid for that impression.

68. While second-price auctions are bidder-truthful, first-price auctions have their own advantages. One important benefit of the first-price auction is its transparency. Unlike in a second-price auction, the winning bidder always pays its bid, so it does not need to trust the auctioneer's computations or reports of floor prices and other bids in order to confirm that the price it pays was determined properly. Among sealed-bid auctions, only first-price auctions are what auction theorists have called **credible auctions**, which means that the auctioneer has no profitable way to cheat that is not immediately detectable by the winning bidder.[92] This credibility property is one reason that first-price

[91] Bid "shading" is a term of art in the economic theory of auctions, dating back to at least the seminal work of William Vickrey. *See* Vickrey, W. (1961). Counterspeculation, auctions, and competitive sealed tenders. *Journal of Finance*, *16*(1), 8-37, at 12-13 ("On the other hand, if traders have a fairly confidently held expectation that the equilibrium price will fall within a certain narrow range, there may be an indirect community of interest in shading the reported demand and supply curves outside this range in the direction of greater inelasticity"). The term has also been used to describe bid optimization in the online display advertising industry.

[92] Akbarpour, M., & Li, S. (2020). Credible auctions: A trilemma. *Econometrica*, *88*(2), 425-67, at 427.

auctions have been preferred in some applications. I discuss additional advantages of the first-price auction format for online display advertising in Section III.C.4 below.

c) Other Auction Formats

69. Other auction formats exist and lead to different incentives for auction participants. One example is the **1.5-price** auction, which charges the winning bidder an amount halfway between its own bid and the second-highest bid. In the 1.5-price auction format, bidders optimize by shading their bids, but to a lesser extent than in the first-price auction. Another example, relevant in online display advertising, is a non-transparent auction, in which the auctioneer might claim to calculate winners and payments according to one rule, but actually charges bidders according to another rule. Because it is so easy to detect the first-price rule, an auctioneer running a non-transparent auction might claim to use a second-price auction but actually use the 1.5-price rule, hoping to confuse bidders into bidding too much, increasing the auctioneer's profit. When non-transparent auctions are possible, optimizing bidders must rely on data about past auction performance and/or on experiments to determine optimal bids into the auction.

d) How Publishers Set Floor Prices

70. Setting a floor price can help increase publisher revenues by ensuring that no impression is ever sold at a very low price. Determining the optimal floor price, however, requires a subtle strategic computation. Raising the floor price may sometimes increase auction revenue, but if it is set too high, there might be no bidder willing to bid more than the floor price. Then, the impression may remain unsold, leading to zero revenues for the publisher and zero surplus for the advertiser.

71. To determine a floor price that maximizes the expected revenue on an impression, a publisher must make a probabilistic assessment of the costs and benefits of each possible floor price, trading off the possible benefit of an increased price in the case that the impression sells against the cost of an increased likelihood that the impression is unsold.

72. As an example of this computation, suppose that a publisher is selling an impression to a single bidder using a second-price auction and knows that it is worth either $1, $2, or $3 to that bidder, each with equal probability. If the publisher sets a floor price of $3, it expects to sell the impression for $3 with probability ⅓, yielding an expected revenue of $1. If it sets a floor price of $1, it will always sell the impression for $1. To maximize its expected revenue, the publisher should set a floor price of $2, which sells the impression with probability ⅔, leading to an expected revenue of $1.33.[93]

73. The above example shows that setting a floor price properly can increase revenues for a publisher in a second-price auction. Setting a floor price can also increase revenues for a publisher in a first-price auction, by reducing the extent to which some bidders shade their bids.

74. In practice, in repeated auction settings, publishers often use simulations on recent auction data or experiments (sometimes known as "A/B tests") of different floor prices on live auctions, and choose the floor price that led to the highest revenue in those simulations or experiments.[94] [redacted]

[93] The publisher could choose floor prices other than $1, $2 or $3, but—by similar calculations to the ones above—any such floor price leads to lower expected revenues than the floor price of $2.

[94] *See, e.g.*, Rhuggenaath, J., Akcay, A., Zhang, Y., & Kaymak, U. (2022). Setting reserve prices in second-price auctions with unobserved bids. *INFORMS Journal on Computing*, *34*(6), 2950-2967.

[redacted][95] [redacted]”[96] There are supply-side intermediaries who assist in this process, as well, including Clickio, which offers floor price optimization tools and other services for publishers to “guarantee maximum revenues.”[97]

4. *The Industry’s Switch from Second-Price Auctions to First-Price Auctions*

75. Early online ad exchanges used second-price auctions to allocate online display advertising impressions.[98] But as online display advertising evolved, new challenges emerged that threatened to undermine the performance of second-price auctions and eventually led many ad exchanges to switch auction rules.

76. *First*, a DSP bidding on behalf of multiple advertisers could increase its profits by submitting only one bid into a second-price auction, instead of submitting bids on behalf of all its advertisers,[99] while continuing to charge advertisers the same threshold prices (preserving the bidder-truthfulness of the auction). If a DSP pursues that strategy, then whenever it hosts the two highest bids for an impression, it ends up paying less for the impression than it would if it submitted bids on behalf of all its advertisers. For example, suppose that the DSP’s two highest bids are $12 and $10 and the highest bid submitted by

[95] [redacted]

[96] [redacted]

[97] Clickio, “Monetization” (accessed Jul. 7, 2024), https://clickio.com/monetization/.

[98] Presentation, “DV360, Third Party Exchanges, and Outcome-Based Buying” (Oct. 16, 2018), GOOG-DOJ-12038253, at -267 (Figure: “Impression Share (US Ad Inventory)”; “Fair Second-Price Auction”: 75% in December 2017, 33% in March 2018).

[99] Submitting bids determined by the values of the two highest-value advertisers would lead to the same outcomes in a second-price auction as submitting bids on behalf of all advertisers.

any other demand source is $8, all higher than the auction's floor price. If the DSP submits both of its bids to the auction, the DSP wins the auction and pays its second bid of $10. If the DSP instead submits just the bid of $12 (and assuming no change in the auction's floor price and the bids of other bidders), then it wins the auction and pays the new second-highest bid of $8. This does not imply, however, that the winning advertiser benefits: by charging the winning advertiser its threshold price, that advertiser pays $10 and the DSP pockets the $2 difference between that amount and the auction's clearing price ($10 - $8), increasing its profits.[100] As in this example, the general result of this DSP's **one-bid strategy** is that the publisher loses revenue. With this strategy, the price paid to the publisher is not a market-clearing price (because at least two advertisers would be willing to pay more than the price of $8), and the DSP can earn an additional profit just by keeping the price difference. Some non-Google DSPs are reported to have done exactly that,[101] and Google observed that many bidders did not submit two bids into the AdX auction.[102]

77. *Second*, some publishers adopted a tactic called **multi-calling**.[103] Instead of calling the exchange with the floor price that it would set in a single auction, these publishers would first call the exchange with an inflated floor price. If advertisers bid truthfully, this first

[100] To see that bidders' incentives are not affected by the DSP strategy, note that the allocations and payments for the bidders are the same under the DSP strategy as in a second-price auction.

[101] *See, e.g.*, Ross Benes, "Ad buyer, beware: How DSPs sometimes play fast and loose," Digiday (May 25, 2017), https://digiday.com/marketing/dsp-squeeze-buyers/ ("[S]ome [DSPs] bill based on a clearing price for the auction that occurred within the DSP's platform that can be higher than the price that won the impression on the open exchange, and the DSP will keep the difference.").

[102] Presentation, "Understanding the AdX Auction" (Oct. 2014), GOOG-DOJ-12443562, at -567 ("[O]ther bidders are allowed to [second-price themselves], but often do not").

[103] "Solving the Multi-Call problem" (Nov. 25, 2019), GOOG-AT-MDL-001397473, at -475 ("Background 2: The multi-call problem").

call might cause a bidder to win the auction at the inflated price. If there was no winner at the high price, the publisher would call the exchange again, offering the same impression with a lower floor price. As a result, if the publisher engages in multi-calling, it is not generally optimal for an advertiser to bid its value: the winning advertiser may be able to buy the impression at a lower price by reducing its bid, letting the impression go unsold in the first auction, and then winning in a later auction at a lower price. Multi-calling destroys the simplicity of threshold pricing and so complicates bidding for advertisers, forcing them to strategize about how best to respond to the publisher's practice and make guesses about the publisher's true floor price and about others' bids. Multi-calling also increases processing costs and adds latency, damaging the end user's online experience and leading to a reduction in advertising effectiveness.[104]

78. *Third*, as online display advertising platforms evolved to accept more bids from different demand sources in each auction, **self-competition**—which occurs when an advertiser submits multiple bids for the same impression—became a larger concern for advertisers. Self-competition can occur as a result of **advertiser multi-homing**,[105] in which an advertiser uses multiple DSPs to submit bids for an impression, or **DSP multi-homing**,[106]

[104] *See, e.g.*, Oded Poncz, "Traffic duplication might be a bigger problem than ad fraud," AdExchanger (Jan. 11, 2016), https://www.adexchanger.com/data-driven-thinking/traffic-duplication-might-even-be-a-bigger-problem-than-ad-fraud/ ("Another side effect of bid request duplication is that re-auctioning a bid takes time. In some cases, this could even become apparent to the end user.").

[105] In a 2021 survey, respondent advertisers and ad agencies (who all spent a minimum of $1M annually on digital ads) used an average of [redacted] DSPs and planned to use [redacted] DSPs the following year. *See* Advertiser Perceptions, "DSP Report: Demand-Side Platforms" (2021), GOOG-DOJ-AT-02524665, at -666, -670. *See also, e.g.*, [redacted]

[106] *See, e.g.*, [redacted]

in which a DSP submits bids into multiple exchanges on behalf of a single advertiser. When the same bidder submits multiple bids in a second-price auction, it may wind up making both of the two highest bids, with its own second-highest bid setting its price. In such cases, the advertiser would pay a lower price if its second bid were lower or omitted. Bidders would need to adjust their bids to avoid this possibility, requiring more complicated bidding strategies.

79. *Fourth*, some exchanges tried to increase their profits by using **non-transparent auctions**, claiming to calculate the winner's price using a second-price rule, but actually charging winners a larger amount, for example by using the 1.5-price rule described earlier.[107] Such practices make participation in the auction less safe for advertisers and reduce trust in online display advertising intermediation more generally, harming other exchanges and economic welfare. In order to protect against non-transparent auctions, bidders would need to invest in costly technology to detect exchanges using non-second-price auction rules and to optimize bids into those exchanges.

80. Many intermediaries adopted practices to reduce the potential harms associated with the four challenges I described above,[108] and eventually ad exchanges across the industry responded by switching away from a second-price auction format. Most exchanges,

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[107] Presentation, "Bidding in adversarial auctions" (Nov. 27, 2017), GOOG-DOJ-05282625, at -635 ("Dirty [auctions are] called second price, but really more like first price"; "Dirtiness is introduced using a new type of floor called a'Soft-floor' […] to achieve a continuum of auctions from second price […] to 1st price […], opaque to the advertiser"; "All these auctions [on exchanges United, AdX, AppNexus, OpenX, Pubmatic] are 'second price,' however the auction discount (cost/bid) varies widely.").

[108] For example, Projects Bell and Poirot at Google were designed to respond to multi-calling and non-transparent non-second-price auctions, respectively. Non-Google display advertising intermediaries also introduced similar products, as demonstrated in Table 1 and discussed below.

including Google's AdX, made the switch to a first-price format between 2017 and 2019.[109]

81. The transition to a first-price auction reduced or eliminated the four concerns I listed above. *First*, in a first-price auction, a DSP cannot reduce a publisher's revenue by suppressing its lower bids because each bidder always pays its highest bid. *Second*, bidders that optimize their bids in first-price auctions using experimentation can reverse some of the losses to multi-calling, making it less likely for that tactic to be profitable.[110] *Third*, in a first-price auction, a bidder gains some protection against self-competition, because unlike in a second-price auction, its losing bids do not affect its own price.[111] *Fourth,* no auctioneer can profit from deceiving a bidder about the correct price: the winning bidder can easily check whether its payment equals its bid.

[109] *See* Presentation, "DV360, Third Party Exchanges, and Outcome-Based Buying" (Oct. 16, 2018), GOOG-DOJ-12038253, at -267 (Figure: "Impression Share (US Ad Inventory)"; "First-price auction": [redacted]% in December 2017, [redacted]% in March 2018). These figures would not include AdX's later transition to a first-price auction in 2019. *See also* Email from [redacted]., "Re: Offering 1st price to publishers?" (Sep. 5, 2017), GOOG-DOJ-05272070, at -075 ("Other exchanges started the migration to 1st price auction recently arguing th[at] it is the best way to integrate it with HB.").

[110] In a first-price auction, bidders typically experiment to identify optimal bids, and—in the face of multi-calling tactics by publishers—such experiments would identify benefits from reducing bids more to multi-calling publishers than non-multi-calling publishers, resulting in similar effects as Project Bell, discussed in Section V below.

[111] A multi-homing advertiser still needs to be mindful of self-competition in first-price auctions, in case one of its buying tools learns to bid more aggressively in response to that same advertiser's higher bids via different buying tools (driving up prices for the advertiser). This is one reason for the emergence of so-called "supply path optimization tools" which help bidders optimize the platforms on which they bid for inventory. *See* Yuyu Chen, "WTF is supply path optimization?," Digiday (May 22, 2023), https://digiday.com/media/what-is-supply-path-optimization/("[Supply path optimization] is essentially an algorithm used by demand-side platforms to streamline how they interact with supply-side platforms. Each DSP has developed its own strategy for supply path optimization: Some use it to pick up the bids that are most relevant and have the highest chance of winning, while others use it to turn off SSPs that are not implementing second-price auctions, according to Tom Kershaw, CTO for ad exchange Rubicon Project. […] Two major reasons [why it is important for DSPs]: Bid duplication and various auction mechanisms used by SSPs.").

D. Google's Products

82. Along with many other companies, Google provides a variety of intermediary services in online display advertising. In this report, I study the practices of a number of Google's intermediaries: on the demand-side, **Google Ads** and **Display & Video 360 (DV360)**, and on the supply-side, **Google Ad Manager (GAM)**, which incorporates advertising exchange functionality (formerly known as **AdX**) and publisher ad server functionality (formerly known as **DFP**).

1. Display & Video 360

a) How Advertisers Use DV360

83. **DV360** (formerly known as DoubleClick Bid Manager or DBM) is a demand-side platform that offers tools for "planning [display advertising] campaigns, […] designing and managing creative[s], organizing audience data, finding and buying inventory, and measuring and optimizing campaigns,"[112] enabling advertisers to "manage their reservation, programmatic, and programmatic guaranteed campaigns across display, video, TV, audio, and other channels, all in one place."[113] As I described above, DV360 offers automated tools to "help make optimal bids to help improve campaign

[112] Google, "Display & Video 360 overview," Display & Video 360 Help (accessed Jan. 21, 2024), https://support.google.com/displayvideo/answer/9059464?hl=en.

[113] Google, "Display & Video 360: An integrated solution for end-to-end advertising campaigns," Display & Video 360 (accessed Oct. 31, 2023), https://services.google.com/fh/files/misc/display_and_video_360_product_overview.pdf.

performance."[114] DV360 allows advertisers to purchase ads from many sell-side platforms, including AdX, Index Exchange, OpenX, Rubicon, and others.[115]

84. Advertisers on DV360 can set up their campaigns in multiple ways. In the early days of DV360, most advertisers used DV360 to set up **fixed CPM** campaigns, in which the advertiser would report to DV360 the characteristics of the impressions they would like to purchase with each campaign and a fixed CPM—cost per mille (thousand impressions)—and DV360 would use that CPM to bid in auctions for those impressions.[116] Fixed CPM bidding is still offered as an option on DV360, but between 2017 and 2020, the majority of DV360 advertisers switched to **automated bidding** campaigns,[117] in which the advertiser reports an objective to DV360 (for example, "maximize clicks" or "maximize conversions" subject to a budget) and DV360 applies prediction and optimization algorithms to "dynamically determine the optimal bid price for a given impression for an advertiser."[118] More recently, DV360 introduced **custom**

[114] Google, "Enhanced automation," Display & Video 360 Help (accessed Oct. 31, 2023), https://support.google.com/displayvideo/answer/6130826?hl=en.

[115] Sissie Hsiao, "How our display buying platforms share revenue with publishers," Google Ad Manager (Jun. 23, 2020), https://blog.google/products/admanager/display-buying-share-revenue-publishers/ ("Using Display & Video 360, these advertisers can buy ads on more than 80 publisher or sell-side platforms including AT&T, Comcast, Index Exchange, OpenX, Rubicon Project, MoPub and others.").

[116] Presentation, "DV360 optimizations ENG deep dive" (Jan. 24, 2020), GOOG-DOJ-11733552, at -553 ("DV360 three years ago: Mostly fixed CPM manual bidding").

[117] Presentation, "DV360 optimizations ENG deep dive" (Jan. 24, 2020), GOOG-DOJ-11733552, at -555 ("Impact on auto-bidding adoption: [redacted]% now").

[118] Comm Doc, "Optimized Fixed Bidding in DV360" (Mar. 2019), GOOG-DOJ-05326023, at -023.

bidding, which allows advertisers to input their own algorithms to determine bids on an impression-by-impression basis.[119]

b) How DV360 Determines Bids and Payments

85. When DV360 receives a bid request from an exchange, it first identifies the advertiser campaigns that are targeting impressions with the characteristics associated with the bid request.[120] As I discuss further in connection to Project Elmo in Section VI below, in order to ensure that advertiser budgets are not depleted too quickly, DV360 then applies its **budget throttling** algorithm to determine a selection of eligible advertisers for participation in the auction for the impression. Among those advertisers, DV360 then determines the advertisers with the highest bids for the impression net of any fees and submits bids to the exchange.[121] If DV360 expects that the exchange is using a non-second-price auction, the submitted bids are adjusted using a bid optimization

[119] Presentation, "DV360, Third Party Exchanges, and Outcome-Based Buying" (Oct. 16, 2018), GOOG-DOJ-12038253, at -270 ("Rule based custom bidding is a new bidding strategy that we are building together with the KIR team. It allows our advertisers and agencies to express what they really value in advertising and optimize towards that value. […] Once they know what features and signals they need, they can […] [w]rite a script on how to evaluate the value of a query in the most generic form. Upload the script to us. We take this script and score all of their historical impression data. Then we learn from that data to bid optimally on future received queries."); Google, "Custom bidding overview and limitations," Display & Video 360 Help (accessed Oct. 31, 2023), https://support.google.com/displayvideo/answer/9723477?hl=en("Custom bidding scripts and goals let you define the value of an impression that aligns with your campaign's goals. Display & Video 360 uses the algorithm from your custom bidding scripts or goals to determine the score it assigns to impressions. The outcome of previously scored impressions helps train the custom bidding model to help optimize your bidding strategy.").

[120] Presentation, "DV360 product and architecture" (Oct. 31, 2018), GOOG-DOJ-15407321, at -363 ("DBM finds fitting Campaigns").

[121] Presentation, "DV360 product and architecture" (Oct. 31, 2018), GOOG-DOJ-15407321, at -363 ("Mixers run auctions between campaigns/systems").

algorithm called Poirot that makes bidding simpler for advertisers.[122] I discuss Poirot in detail in Section VII.

86. If the DV360 bid wins the auction, the advertiser with the highest bid in DV360 is allocated the impression and pays the clearing price of the exchange auction, plus any fees charged by DV360. The fees charged to a given advertiser are determined by contracts negotiated between Google and the advertiser, and they include platform fees that are typically a fixed percentage of the total price of each impression.[123] Prior to August 2023, DV360 advertisers could also elect to be charged for impressions on a "pay per outcome" basis, in which they paid only if the end user engaged with the ad according to some predetermined outcome measure (similar to payments by some Google Ads advertisers, discussed below).[124, 125]

[122] Presentation, "DV360 product and architecture" (Oct. 31, 2018), GOOG-DOJ-15407321, at -363 ("DBM Frontend translates the Bid for the Exchange"); Design Doc, "Poirot Design Doc" (Apr. 25, 2017), GOOG-DOJ-13627809, at -809 ("Over [redacted] of DBM bidding goes through third-party exchanges […] Fixed CPM bidders have the same bid in these unclean exchanges as they do in clean exchanges […] The goal of Poirot is to discover the exchanges that deviate from second pricing and bid appropriately on these").

[123] *See* "FY22 - DV360 (DBM) Narrative" (Jul. 12, 2023), GOOG-AT-MDL-008930706, at -713 to -715 ("DBM Partners (a term used interchangeably with advertisers or customers) must have an Advertising Platform Agreement (APA) or Affiliates Adopting Agreement (AAA) in place with Google in order to use DoubleClick products. […] The standard DBM deal structure is to charge customers a platform fee (*i.e.* license/technology fee) based on transaction type."). Google may also charge advertisers on DV360 ad serving fees for third-party services or technologies, and fees for access to certain types of data from third-party providers.

[124] *See* Design Doc, "Pay per Outcome in DBM" (Feb. 10, 2018), GOOG-AT-MDL-009590288, at -289 ("In this document, we discuss a detailed design to make outcome based buying possible on DBM.").

[125] This service has now been deprecated. *See* Google, "Coming soon: April 17, 2023 edition," Display & Video 360 announcements (Apr. 17, 2023), https://support.google.com/displayvideo/answer/13511229 ("Outcome based buying will be deprecated on August 1 (previously communicated as July 1), 2023").

2. Google Ads

a) How Advertisers Use Google Ads

87. **Google Ads** (formerly known as AdWords) is a buy-side tool that permits advertisers to create ad campaigns that run across different formats, including search and display ads.[126] In this report, I focus on the online display advertising functions of Google Ads on web properties other than those owned and operated by Google.

88. Advertisers on Google Ads specify campaign goals (*e.g.*, maximizing clicks or conversions) and constraints for a campaign (*e.g.*, types of end users to target, maximum bids or budgets), and Google Ads uses that information to determine bids for impressions.[127] Advertisers can also specify "manual" bids for impressions on a CPC (cost-per-click) or CPM basis.[128] In this report, for simplicity, I use the word "bid" to refer to either the manual bid reported by the Google Ads advertiser or the bid determined by Google Ads as a function of the advertiser's reported campaign goals, whichever is relevant for that advertiser.

89. Originally, beginning in 2003, advertisers could use Google Ads to buy third-party display advertising inventory only from publishers using AdSense, a Google supply-side

[126] Google, "Google Ads" (accessed Jan. 5, 2024), https://ads.google.com/intl/en_us/home/.

[127] Google, "Determine a bid strategy based on your goals," Google Ads Help (accessed Oct. 31, 2023), https://support.google.com/google-ads/answer/2472725 ("Depending on which networks your campaign is targeting, and whether you want to focus on getting clicks, impressions, conversions, or views you can determine which [bidding] strategy is best for you.").

[128] Google, "Determine a bid strategy based on your goals," Google Ads Help (accessed Oct. 31, 2023), https://support.google.com/google-ads/answer/2472725 ("Manual CPC bidding: This lets you manage your maximum CPC bids yourself. […] CPM: With this bid strategy, you'll pay based on the number of impressions (times your ads are shown) that you receive").

product.[129] After the acquisition of DoubleClick and the 2009 launch of AdX 2.0, advertisers could also use Google Ads to purchase inventory from AdX.[130] Since the beta launch of **AwBid** in May 2013 and its general launch in June 2015, advertisers have also been able to use Google Ads to purchase some types of inventory through non-Google ad exchanges.[131] Google Ads has its own bid optimization program for non-Google exchanges called **Marple**, which worked similarly to Poirot on DV360, determining optimal bids for Google Ads advertisers in non-second price auctions.[132] The AwBid program has grown over time, but the majority of Google Ads' total online display advertising spend is on AdX.[133]

b) How Google Ads Determines Bids into AdX: The Internal Auction

90. When Google Ads is called to bid on an impression, it uses an internal process which I will call the **Google Ads internal auction** (and which Google employees refer to as the

[129] Email from [redacted] to [redacted], "Final Google AdSense press release" (Jun. 8, 2003), GOOG-DOJ-01805208, at -208 ("With Google AdSense, publishers serve text-based Google AdWords ads on their site and Google pays them for clicks on these ads[.]").

[130] Email from [redacted], "Re: [Adsense-eng-wat] [Adsense-eng] Re: [Ads-engdirs] Doubleclick Ad Exchange 2.0 - Launched!" (Sep. 19, 2009), GOOG-AT-MDL-010836318, at -318 ("The team has done a great job […] to also go beyond in some important areas, *e.g.* […] integration with Adsense and Adwords.").

[131] Email from [redacted] to [redacted], "Fwd: [adsense-doubleclick-pm] Launch of AWBid: Cross-exchange Buying for AdWords Remarketing" (May 9, 2013), GOOG-DOJ-09916352, at -352 ("I am happy to announce the launch of AWBid in a closed beta in North America. AWBid stands for AdWords Bidder and enables cross-exchange buying for AdWords remarketing campaigns."); Email from [redacted] to [redacted], "[Launch 127698] AWBid Cross-exchange Pilot for AdWords Remarketing" (Jan. 26, 2015), GOOG-DOJ-14514871, at -871 ("AWBid (AdWords Bidder) will allow AdWords campaigns to buy inventory on third party exchanges via RTB integration.").

[132] Design Doc, "Poirot for AWBid Design Doc" (Sep. 10, 2018), GOOG-DOJ-AT-02512863, at -863 ("Motivated by project Poirot, project Poirot for AWBid (A.K.A Marple) aims to provide optimal bidding strategy for GDN advertisers to buy on non-second price exchanges.").

[133] As of 2019, AwBid accounted for approximately [redacted]% of Google Display Ads' total remarketing spend. *See* Presentation, "AWBid Overview" (Sep. 5, 2019), GOOG-DOJ-14298902, at -909 ("[redacted]% of GDA remarketing revenue is from Awbid.").

"Google Display Network (GDN) Auction," the "CAT2" auction, or the "pre-auction"[134]) to determine the bid that Google Ads makes and the advertiser to be allocated the impression if that bid wins.[135] In a first step, Google Ads (like DV360) identifies the advertiser campaigns targeting impressions with the characteristics associated with the bid request and applies its budget throttling algorithm to determine a selection of those campaigns for participation in the auction for the impression.[136] Next, Google Ads converts all of its advertisers' bids into the same **eCPM** basis, which is the expected cost per thousand impressions. For example, to convert an advertiser's value from cost-per-click or cost-per-conversion to eCPM, Google Ads multiplies that advertiser's reported value per click or conversion by a predicted click or conversion rate, which it estimates using a proprietary algorithm.[137] I refer to this eCPM bid as the advertiser's **value** for the impression.[138] Next, Google Ads converts each of these values to a "score,"

[134] Design Doc, "Dynamic Revshare for AdWords on AdX" (Jul. 13, 2012), GOOG-DOJ-13605152, at -152 ("Currently, AdWords runs an auction (aka CAT2 auction, pre-auction) to select the highest bidding creative (or bundle of creatives) to compete in the AdX auction.").

[135] "GDN Auction Overview" (Oct. 11, 2014), GOOG-AT-MDL-001094067, at -068 ("The GDN auction decides which ads we serve to users for each query."); *see* Presentation, "Auction Overview" (Dec. 2019), GOOG-DOJ-13979867, at -872 to -876.

[136] Overview Doc, "GDN Auction Overview" (Oct. 11, 2014), GOOG-AT-MDL-001094067, at -068 ("Prior to the auction, the CAT Mixer also applies other filters such as Budget filtering, and so on."); Email from [redacted] to [redacted], "[Launch 205617] Cookie-based budget throttling for GDN advertisers" (Jul. 23, 2018), GOOG-DOJ-15116057, at -057 ("Cookie-based throttling means keying the throttling decision on cookie instead of making an independent decision per query (see design doc for more details). [...] We are now following up to launch on GDN as well.").

[137] *See* Declaration of N. Jayaram (Aug. 5, 2023), GOOG-AT-MDL-008842383, at ¶¶ 4-5 ("Sometimes advertisers use automated bidding products, where instead of providing bids directly, they provide goals (*e.g.*, maximize conversions) and constraints (*e.g.*, budget). Automated bidding systems translate these goals and constraints to an impression value […] To determine which bid Google Ads will submit to AdX, Google computes the impression value for eligible ad candidates so that they can be compared in the same cost units."); "GDN Auction Overview" (Oct. 11, 2014), GOOG-AT-MDL-001094067, at -070 ("The GDN auction uses the CPM cost type in micros as the standard unit. […] For other cost types, the auction multiplies the bid by a prediction of user interaction.").

[138] Google sometimes also internally refers to the eCPM as the advertiser's value. *See* "GDN Auction Overview" (Oct. 11, 2014), GOOG-AT-MDL-001094067, at -073 ("Each auction ranks the participants according to a metric named Advertiser Value. Advertiser Value represents the maximum return that an advertiser expects to earn by winning a particular place in the auction."), -074 ("Within GDN, we use MaxEcpm as a proxy for advertiser value").

deducting the Google Ads revenue share to obtain a "net" bid and adjusting in some cases by factors representing the ad's quality and relevance to the user.[139] Finally, Google Ads bids for the impression on behalf of the highest-scoring advertiser (hereinafter, for simplicity, the "highest bidder" on Google Ads).[140]

91. By calculating bids on behalf of advertisers, Google Ads makes it easier for advertisers to participate effectively in auctions for impressions. Even though Google Ads bids into auctions on a per-impression basis, it allows advertisers that mainly care about user engagement—clicks or conversions—to specify a budget and/or values per-click or per-conversion, and Google Ads uses this information to compute bids in the auction on their behalf. With threshold pricing, this hybrid process is bidder-truthful: advertisers are incentivized to report their values per click or per conversion truthfully to Google Ads. In addition, as long as Google predicts engagement rates accurately, this process provides a valuable service, placing bids on behalf of advertisers that are just the same as if advertisers could compute value per impression themselves and pay for each impression according to the threshold pricing rule. For this reason, in the remainder of this report, when I talk about a Google Ads advertiser's payment for an impression, I am referring to the price it would pay if it paid on a per-impression basis (which would be the same, on average, as their actual payments to Google Ads).

92. The process used to determine the Google Ads bid into AdX on behalf of the highest-scoring advertiser has been updated and improved multiple times to increase

[139] "GDN Auction Overview" (Oct. 11, 2014), GOOG-AT-MDL-001094067, at -071 ("The scoring operation produces the final bid for each candidate by including quality-based adjustments. […] During scoring, the auction calculates bid adjustments and fees, then applies the adjustments to the candidates.").

[140] "GDN Auction Overview" (Oct. 11, 2014), GOOG-AT-MDL-001094067, at -080 ("The bid that we send to AdX is the actual maximum that our advertiser is willing to pay.").

advertiser profits in response to changing auction dynamics. Initially, Google Ads had a **two-bid policy**, in which it submitted two bids equal to its estimates of the two highest eCPMs that it had estimated among its advertisers (net of a fixed Google Ads revenue share).[141, 142] After adjusting for its revenue share, the two-bid policy replicated the outcome of the second-price auction in which each of its advertisers submitted and determined bids individually. In 2013, in response to other bidders "increasingly thinning their margins to win on volume," Google Ads introduced bid optimization programs, **Dynamic Revenue Share for AdWords** (hereinafter **buy-side DRS**) and its successor, **Project Bernanke**.[143] These programs varied the revenue share charged on a per-impression basis, allowing Google Ads advertisers to win more impressions and allowing publishers to sell more impressions.

93. In 2016, Google Ads launched **Project Bell** which modified its bidding program to protect its advertisers from the publisher tactic called multi-calling, which would otherwise reduce advertisers' surplus. In 2018, Google Ads introduced **Project Elmo** which is a similar program to ensure consistent determination of bids for impressions in

[141] In practice, Google Ads may have submitted one bid with a "minimum payment" field, which specified the least price it would pay if its bid won the auction. All bidders in the AdX auction had the option to use the same field. In practice, the effect of such a field is exactly the same as the effect of submitting two bids, so I do not distinguish them in the remainder of this report. *See* Design Doc, "Call-out-Proxy: 1-bid, 2-bid, and min-bid" (Feb. 24, 2012), GOOG-DOJ-03366145, at -145 ("Engineering suggestion: Each ad-network transfers a single bid, with an added field: a minimum price that needs to be paid if its bid wins."); Launch Doc, "RPO Exemption Policy V2 Launch Doc" (Nov. 14, 2017), GOOG-DOJ-13212948, at -948 ("The current policy (b/18573816) exempts a buyer network on a specific ad query if we see either more than one open auction bid submitted by the network, or a single bid that specifies a minimum payment.").

[142] I use the term "two-bid policy" to describe the pre-2013 Google Ads bidding program. I note that Google Ads continued to submit two bids into AdX auctions during its later bid optimization programs, but these bids were calculated differently (and, in Project Bernanke, the low bid was sometimes zero).

[143] Email from [redacted] to [redacted], "Re: GDN Dynamic Revshare launched today!" (Jan. 17, 2013), GOOG-DOJ-[redacted], at -227.

the face of publisher multi-calling and bid duplication tactics from non-Google exchanges.[144]

94. In 2019, Google Ads further revised its bidding program to make it easier for advertisers to bid in response to AdX's transition to a Unified First Price Auction, with this most recent bidding program called **Alchemist**.

95. I discuss these Google Ads bidding programs and their benefits for advertisers in detail in Section IV, where I also respond to allegations made by Plaintiffs about these programs.

3. *Google Ad Manager*

a) How Publishers Use GAM

96. **Google Ad Manager (GAM)** is a supply-side platform that includes publisher ad server functionality and the real-time auction capabilities of an ad exchange.[145] The ad server capabilities were previously called **DoubleClick for Publishers (DFP)**, and the ad exchange capabilities were previously called **Ad Exchange (AdX)**. These features were integrated into GAM between 2014 and 2018.[146] In this report, where historically appropriate or where the distinction between the ad server capabilities and real-time

[144] Email from [redacted] to [redacted] "[Launch 205617] Cookie-based budget throttling for GDN advertisers" (Dec. 6, 2018), GOOG-AT-MDL-015521456, at -456 ("Launch Date [...] 2018-11-19").

[145] *See* Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ft. 1.

[146] Sridhar Ramaswamy, "Introducing simpler brands and solutions for advertisers and publishers," Google Blog (Jun. 27, 2018), https://blog.google/technology/ads/new-advertising-brands/ ("[W]e've been working to bring together DoubleClick for Publishers and DoubleClick Ad Exchange in a complete and unified programmatic platform under a new name—Google Ad Manager."). Originally, this merged entity was internally called DRX (DoubleClick Reservations and Exchange). *See* Product Requirements Doc, "The 2015 Unified/Integrated DRX Query Tool (a.k.a Project Brundlefly)" (Feb. 5, 2015), GOOG-TEX-00048091, at -093 ("In July 2014, the DoubleClick for Publishers (DFP) and DoubleClick Ad Exchange ads products were merged to form a new product called DoubleClick Reservations & Exchange (DRX). The underlying goal of DRX is to unify the various features offered by both DFP and AdX together to create a more streamlined product experience.").

auction capabilities of GAM is particularly important, I use the older names, DFP and AdX.

97. Publishers include code snippets (called **Google Publisher Tags** or **GPTs**) in their web pages to trigger a **call** or **ad request** to GAM.[147] This ad request contains information about the impression opportunity, including the URL of the website, any available user-related information, and characteristics of the impression opportunity (including its size and location on the page).[148] After an ad request is received, GAM uses decisioning logic to determine which ad to serve.[149] Publishers configure this decisioning logic in the GAM interface using various controls, including **line items**.[150]

98. Line items are GAM's way of encoding information about sources of advertising demand.[151] **Guaranteed line items** are the line items used for campaigns for which the advertiser and publisher have a directly negotiated contract.[152] Guaranteed line items contain information about the advertiser's campaign goal (*e.g.*, number of impressions,

[147] Presentation, "Ad Manager Ecosystem 101" (Jun. 2019), GOOG-DOJ-AT-02199478, at -487 to -488 ("GPT is a Javascript library that publishers use to tag their web pages so they can talk to Google Ad Manager backend.").

[148] Presentation, "Ad Manager Ecosystem 101" (Jun. 2019), GOOG-DOJ-AT-02199478, at -488 ("The Ad Request contains information about the impression: URL of the site[,] Browser User Agent[,] Slot parameters (Ad Unit, size, key/value pairs)[,] etc. Ad Request also contains user-related information like Cookies, User IDs, etc, that can be later at the backend matched to user demographics and behavior profiles, audience segments, etc.").

[149] Presentation, "Ad Manager Ecosystem 101" (Jun. 2019), GOOG-DOJ-AT-02199478, at -492 ("When AdManager receives an ad request, it goes through an ad selection process to pick the Line Item or Yield Group that will serve.").

[150] Presentation, "Ad Manager Ecosystem 101" (Jun. 2019), GOOG-DOJ-AT-02199478, at -490.

[151] *See* Presentation, "Ad Manager Ecosystem 101" (Jun. 2019), GOOG-DOJ-AT-02199478, at -490 ("Line Items represent campaigns / campaign elements within AdManager.").

[152] Google, "Line item types and priorities," Google Ad Manager Help (accessed Jan. 7, 2024), https://support.google.com/admanager/answer/177279?hl=en ("Guaranteed line items […] Standard […] Use this line item type for directly sold campaigns when your buyer wants a specific number of impression[s] to serve.").

clicks), campaign duration, campaign priority, frequency, and targeting criteria.[153] **Non-guaranteed line items** can be used to represent sources of demand for **remnant impressions**, which are impressions not allocated to guaranteed contracts. Those sources of demand include ad networks and non-Google ad exchanges.[154] Until the introduction of EDA in 2014 (see Section III.D.3.e below), guaranteed line items were always prioritized over non-guaranteed line items.[155] Other types of line items can be used to trigger calls to auctions on AdX.[156] Different line items may be relevant for different ad opportunities, depending on publisher decisions in the GAM interface.

b) Early Online Display Advertising and the Waterfall

99. In the early 2000s, online display advertising impressions were primarily sold via either directly negotiated guaranteed contracts between publishers and advertisers, or non-guaranteed contracts between publishers and **ad networks**.[157] Ad networks typically offered to purchase remnant impressions at a fixed or pre-negotiated price, with no

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[153] *See* Presentation, "Ad Manager Ecosystem 101" (Jun. 2019), GOOG-DOJ-AT-02199478, at -490 ("Line Items define things line [sic]: Campaign goal (how many impressions, clicks, etc)[,] Campaign duration[,] Campaign priority[,] Frequency capping (how often should it appear for one user)[,] Targeting (where and to whom should the campaign serve)").

[154] Google, "Line item types and priorities," Google Ad Manager Help (accessed Jan. 7, 2024), https://support.google.com/admanager/answer/177279?hl=en ("Any third-party ad network or exchange that provides an appropriate ad tag can be represented by a non-guaranteed line item").

[155] Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 12 ("From the launch of Dynamic Allocation in around 2007 until Google introduced Enhanced Dynamic Allocation in 2014, line items determined to be 'guaranteed' on a request were always served without considering AdX, AdSense, or any line items determined to be 'non-guaranteed' on that request.").

[156] Presentation, "Ad Manager Ecosystem 101" (Jun. 2019), GOOG-DOJ-AT-02199478, at -491 ("There are 3 main Line Item types in AdManager with subtypes that differ by campaign goal").

[157] *See* White Paper, "Profiting from Non-Guaranteed Advertising: The Value of Dynamic Allocation & Auction Pricing for Online Publishers" (2010), GOOG-DOJ-06818412, at -413.

obligation on the publisher to fill a minimum number of impressions.[158] As compared to direct deals, ad networks typically did not give a publisher as much control over the ads that would be placed on its website, or the prices it received for any individual impression.[159] While direct contracts and ad networks continue to play an important role in online display advertising, over time, more sophisticated technologies emerged to allow publishers and advertisers to identify more valuable matches.

100. One technology that emerged early in the online display advertising industry was the capability of ad networks to "passback" an unwanted impression for which they did not have a relevant advertisement, allowing the publisher to offer the impression to other demand sources.[160] This passback capability led to the **waterfall**, in which a publisher specified (using code snippets called "passback tags") a list of demand sources to be contacted sequentially.[161] In a waterfall, the first demand source was offered the

[158] White Paper, "Profiting from Non-Guaranteed Advertising: The Value of Dynamic Allocation & Auction Pricing for Online Publishers" (2010), GOOG-DOJ-06818412, at -413 ("Publishers usually sell their remaining ad space on a non-guaranteed (or 'pre-emptible') basis through their direct sales channel, as well through their indirect sales channel, which may comprise a handful of ad network partners. […] Non-guaranteed ads […] typically sell at a lower price because of the potential that another buyer will pay a higher price after the initial sale, before the impression is actually delivered; hence the 'non-guaranteed' status. With indirect sales, the CPM is usually fixed, but the number of impressions delivered is not.").

[159] *See* David Kaplan, "On Ad Networks: Pork Bellies, Diamonds, Or The New Direct Marketing?," Forbes (Apr. 8, 2008), https://www.forbes.com/2008/04/08/online-ad-networks-tech-cx_pco_0408paidcontent.html?sh=7414ef02cb8e ("All ad networks are not created equal: If all sides can agree on one thing, it's the need for greater clarity to what's being sold and where it's being placed. […] 'In a lot of cases [in terms of ad nets' handling of remnant, or unsold ad inventory], the buyer doesn't really know what they're getting. And the seller doesn't have any control over price.'"). *See also* AffiliateSeeking.com, "Ad Networks" (captured on Jan. 16, 2008), https://web.archive.org/web/20080116101025/https://www.affiliateseeking.com/list/23000001/1.html (listing some examples of ad network pricing options).

[160] Presentation, "Ad Manager Ecosystem 101" (Jun. 2019), GOOG-DOJ-AT-02199478, at -503 ("Passback means that when one ad system cannot fill an ad request it passes it back to a different ad system.").

[161] *See* Maciej Zawadziński and Mike Sweeney, "What is Waterfalling and How Does it Work?," Clearcode Blog (Sep. 1, 2016), https://clearcode.cc/blog/what-is-waterfalling/("Waterfalling, also known as a daisy chain or waterfall tags, is a process used by a publisher to sell all remnant inventory. […] Waterfalling gets its name from the waterfall-like process for selling inventory—*i.e.* the demand sources are initiated one at a time, one after another."); Presentation, "Ad Manager Ecosystem 101" (Jun. 2019), GOOG-DOJ-AT-02199478, at -503.

opportunity to fill an impression. If that demand source declined to fill the impression (or did not have an eligible ad to serve for the impression), the request was passed back to the next demand source on the publisher's list, with the process repeating until the impression was sold or the publisher's list was exhausted, leaving the impression unsold. The waterfall was a highly configurable process, with publishers free to set the order of consideration and prices for each demand source however they wished.

c) AdX Uses Auctions to Match Publishers and Advertisers

101. **AdX** (formerly known as DoubleClick Advertising Exchange or DoubleClick AdX) launched in 2007 and was designed to "bring Web publishers and advertising buyers together on a Web site where they can participate in auctions for ad space."[162]

102. When AdX receives a call from DFP, it runs an auction on behalf of a publisher.[163] This call contains information about the impression and a floor price for the auction. Prior to 2009, buyers did not vary bids based on real-time information about impressions: instead, if an ad opportunity with certain criteria matching the buyer's stated criteria became available, AdX would run an auction using each buyer's *pre-determined* bid for that type of impression.[164] Since the launch of AdX 2.0 in September 2009, AdX has supported **real-time bidding**.[165] Under real-time bidding, AdX sends bid requests containing

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[162] AdX was originally launched by DoubleClick, prior to its acquisition by Google. *See* Louise Story, "DoubleClick to Set Up an Exchange for Buying and Selling Digital Ads," New York Times (Apr. 4, 2007), https://www.nytimes.com/2007/04/04/business/media/04adco.html.

[163] Presentation, "Ad Manager Ecosystem 101" (Jun. 2019), GOOG-DOJ-AT-02199478, at -513.

[164] *See* DoubleClick, "Ad Selection Specifications for Ad Server Version 14.1" (Mar. 27, 2007), GOOG-AT-MDL-007374059, at -136.

[165] Email from [redacted] to [redacted] "Re: [Adsense-eng-wat] [Adsense-eng] Re: [Ads-engdirs] Doubleclick Ad Exchange 2.0 - Launched!" (Sep. 19, 2009), GOOG-AT-MDL-010836318, at -318 ("The team has done a great job

information about the auction to **Authorized Buyers** (previously known as "AdX buyers" and consisting mostly of ad networks and non-Google DSPs), and triggers a request to Google's buy-side products, Google Ads and DV360, to calculate bids.[166] AdX then runs an auction using the bids that it receives, and it then returns the winning ad to DFP, which serves the ad to the publisher's website.[167] Since the launch of Open Bidding, discussed further in Section III.D.3.g and Section XIII, GAM has also incorporated bids on impressions from non-Google exchanges for publishers that enable it.

103. From its launch until 2019, AdX used a second-price auction to allocate impressions.[168, 169] The highest bid, net of the AdX revenue share, would win the auction as long as that net bid was above the floor price. AdX would then charge the winning bidder its threshold price, which is equal to the higher of the second-highest bid in AdX or the auction's floor price.[170] In April 2015, DFP introduced a feature called **Reserve Price Optimization (RPO)** (also known as **Optimized Pricing**) which helped publishers set floor prices in the AdX second-price auction by increasing some floor prices in bid requests to buyers when RPO predicted—based on historical data on the distribution of

[…] to also go beyond in some important areas, *e.g.* […] Real Time Bidding, and of course integration with Adsense and Adwords.").

[166] Presentation, "Ad Manager Ecosystem 101" (Jun. 2019), GOOG-DOJ-AT-02199478, at -500 to -502 ("The buyer facing side of Google Ad Exchange is called Authorized Buyers […] Ad Exchange sends a Bid Request to DSPs with this information asking them to bid on the impression.").

[167] Presentation, "Ad Manager Ecosystem 101" (Jun. 2019), GOOG-DOJ-AT-02199478, at -502.

[168] *See* Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 5.

[169] During the period in which DRS v1 and v2 was in effect, AdX would charge the winning bidder a price higher than the second-price in a small minority of auctions. See Section XII below.

[170] As noted above, DRS v1 and v2 could change the price paid by advertisers for some impressions.

bids—that the higher floor prices would increase publisher revenues.[171] I discuss RPO in detail in Section XI.

104. In 2019, AdX transitioned to a first-price auction, which I discuss in more detail in Section XIII below.[172]

105. AdX uses a revenue share model to charge publishers for impressions sold on AdX.[173] AdX keeps a proportion of the total revenue from the sales of the publishers' impressions on AdX in a given calendar month, with this proportion referred to as the **AdX revenue share**. The remaining proportion of the revenue, which is passed on to the publisher, is called the **publisher's revenue share**. In combination with the auction's pricing rule (which determines the price paid by bidders in the auction), the revenue share split determines the total payments AdX makes to each publisher. The baseline AdX revenue share is 20%, but different types of transactions can have different revenue shares, and the revenue share could be changed by contract between AdX and the publisher.[174] Until

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[171] Email from [redacted] to [redacted], "Re: [drx-pm] LAUNCHED! Dynamic Pricing (RPO) for AdX sellers" (Nov. 12, 2015), GOOG-DOJ-07235914, at -915 ("Between April and October we launched and improved new systems to dynamically set auction reserve prices for AdX sellers."); Comms Doc, "Optimized pricing in the Open Auction Comms" (Mar. 23, 2018), GOOG-DOJ-04937154, at -154 ("Optimized pricing in the Open Auction […] formerly known as Reserve Price Optimization (RPO)").

[172] Sam Cox, "Simplifying programmatic: first price auctions for Google Ad Manager," Google Ad Manager (Mar. 6, 2019), https://blog.google/products/admanager/simplifying-programmatic-first-price-auctions-google-ad-manager/ ("in the coming months we'll start to transition publisher inventory to a unified first price auction for Google Ad Manager."); Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 7.

[173] Presentation, "Ad Manager Ecosystem 101" (Jun. 2019), GOOG-DOJ-AT-02199478, at -514 ("Revenue share is the pricing model for Ad Exchange.").

[174] *See* Google, "Google Platform Services Terms and Conditions," Google (accessed Sep. 27, 2023), https://www.google.com/google-ad-manager/platform/terms/, at Section 4.1.a; Presentation, "Ad Manager Ecosystem 101" (Jun. 2019), GOOG-DOJ-AT-02199478, at -514 ("Baseline revenue share is 80/20 which means that of every dollar an advertiser pays (Gross value), 80 cents go to publisher and 20 cents go to Google. […] Different types of transactions might have a different revenue share and this might be negotiable during contracting phase.").

August 2015, a publisher would receive the same, fixed revenue share on each impression won by AdX.[175] After the introduction of **Dynamic Revenue Share for AdX** (hereinafter **sell-side DRS**) in August 2015, and until AdX transitioned to a Unified First Price Auction in 2019, AdX allowed the revenue share to vary on individual impressions to sell more total impressions and to increase the overall returns to publishers, as I discuss further in Section XII below. AdX does not generally charge fees to advertisers.[176]

106. The revenue share model helps to align the interests of Google and publishers. Each publisher and Google receive a fixed proportion of the publisher's monthly sales revenue on AdX, so that both parties share in any additional revenues when the total volume or the average price per impression of sales on AdX increases. This degree of alignment allows publishers to safely delegate certain decisions to Google and to benefit from Google's efforts to make its marketplace thicker and more efficient.

d) Dynamic Allocation Benefits Publishers and Improves Efficiency

107. In 2007, DoubleClick introduced **Dynamic Allocation (DA)** in DFP.[177] Using DA, publishers could configure DFP to ensure that the impression was sold on AdX only when an AdX buyer was willing to pay *more* than the amount the publisher expected to

[175] "AdX dynamic sell-side rev share (DRS v1) - project description / mini PRD" (Aug. 2014), GOOG-DOJ-03619484, at -484 ("There is a 20% share on all transactions"); Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 28.

[176] Presentation, "Ad Manager Ecosystem 101" (Jun. 2019), GOOG-DOJ-AT-02199478, at -514 ("Ad Exchange does not impose a buy-side fee").

[177] Dynamic allocation was created by DoubleClick prior to its acquisition by Google. *See* User Guide, "DoubleClick Advertising Exchange User Guide (Beta)" (Mar. 29, 2007), GOOG-DOJ-AT-01133273, at -277 ("Dynamic allocation for sellers. DoubleClick Advertising Exchange automatically determines how to generate the highest return for every impression by dynamically allocating to the highest paying sales channel.").

receive from any other demand source.[178] In contrast to previous ad allocation technologies (including the waterfall), when impressions were sold to AdX buyers, payments to publishers under DA were determined using an auction process, which ensured that the price of each impression was determined by bidders' demands.

108. DA worked as follows. For each remnant line item in DFP (representing, for example, an ad network), publishers would configure a **value CPM** (sometimes called a **static bid**), which determined how that remnant line item would compete with AdX demand under DA.[179] Publishers could set the value CPM for each remnant line item as they pleased and could create multiple line items with different targeting criteria for the same demand source to allow different value CPMs to be used for different categories of impressions.[180] Given these value CPMs, DA used a two-step process to allocate remnant impressions.[181] First, it would identify the eligible[182] non-guaranteed line item with the highest value CPM, called the **DFP booked price** for the auction. In the second step, AdX would run a second-price auction among its demand partners, with a floor price that was at least as

[178] White Paper, "Profiting from Non-Guaranteed Advertising: The Value of Dynamic Allocation & Auction Pricing for Online Publishers" (2010), GOOG-DOJ-06818412, at -413 ("Instead of randomly rotating other ads into an ad slot, DoubleClick Ad Exchange uses Dynamic Allocation, rotating in higher-paying ads from ad networks and other third-party media buyers when the net CPM they provide to the publisher is higher than what has been booked directly into the ad server.").

[179] Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 11; Google, "Value CPM," Google Ad Manager (accessed Oct. 15, 2023), https://support.google.com/admanager/answer/177222?hl=en("The value CPM (cost per thousand impressions) is an amount you specify to help Google Ad Manager estimate the value of campaigns. The amount entered in the 'Value CPM' field serves two purposes: 1. It's used in revenue calculations for impressions served. 2. When a value CPM is defined for remnant line items, the value CPM is used for competition in dynamic allocation and First Look instead of the 'Rate' value.").

[180] Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 11.

[181] *See* Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 10.

[182] A line item was "eligible" if the impression met the terms of the non-guaranteed contract between the publisher and the demand source (*e.g.*, based on targeting criteria).

high as the DFP booked price.[183] If a buyer on AdX was willing to pay more than the floor price, it was awarded the impression and paid the auction's clearing price (adjusted for the AdX revenue share); otherwise, the impression was allocated to the best non-guaranteed line item (which might then passback the impression to other demand sources, as in the waterfall).[184]

109. DA benefited publishers and improved efficiency, increasing the total value of online display advertising to advertisers. If publishers set a value CPM for each line item that was at least as large as the expected return from allocating an impression to that demand source, DA was a *risk-free improvement in their expected revenue*: DA would assign an impression to AdX only if it could pay more than the return the publisher expected from any other demand source. Advertisers also benefited from the ability to make higher bids for impressions they valued highly and lower bids for impressions they valued less in the AdX auction, allowing them to focus their spending on impressions they valued the most. These benefits of DA were amplified when AdX transitioned to real-time bidding in 2009.

110. I provide a more detailed analysis of the benefits of DA in Section VIII.

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[183] If the publisher had otherwise set a floor price for the impression that was higher than the DFP booked price, that floor price would apply.

[184] Presentation, "Understanding the AdX Auction" (Oct. 2014), GOOG-DOJ-12443562, at -582 ("If we decide to call other network and they have nothing, they can pass it back"); Vijay Sivasubramanian, "Help me with Waterfall setup and understanding Passback Tags," Google Ad Manager Help (Mar. 6, 2019), https://support.google.com/admanager/thread/2065360/help-me-with-waterfall-setup-and-understanding-passback-tags?hl=en("You need to give the passback tag which you generated in GAM to the respective network partner. They will place that passback tag as backup ads. So that it will call next ad partner when you target the passback ad unit."); Stack Overflow, "What are advertising passback tags and common implementation" (Feb. 19, 2014), https://stackoverflow.com/questions/19112923/what-are-advertising-passback-tags-and-common-implementation ("When your primary ad-network doesn't have anything to serve (for example, there isn't an advertiser willing to pay a high enough CPM), you can send that impression back to your default advertiser's tags to serve. […] Passback tags allow you to implement a so-called waterfall model").

e) Enhanced Dynamic Allocation Benefits Publishers and Improves Efficiency

111. In March 2014, DFP introduced **Enhanced Dynamic Allocation (EDA)**, which selected the impressions that would be used to serve guaranteed line items in a way that could maximize publisher revenue.[185] Prior to EDA, publishers would first determine whether an impression would be used to fulfill a direct contract, without checking on the bid available from AdX and other remnant demand sources. This procedure left money on the table by allowing an impression to be assigned to a guaranteed contract when it could have otherwise attracted a high price from remnant demand, while another eligible impression not assigned to the guaranteed contract either went unsold or attracted only a low price from remnant demand.

112. Google engineered EDA carefully to avoid such losses. It first estimated the distribution of bids using data from past impressions that were eligible to fulfill the guaranteed contract. It used that distribution to compute a **temporary CPM** for each guaranteed line item, which Google described (correctly) as the opportunity cost of not assigning an impression to the guaranteed contract.[186] The temporary CPM of the best eligible guaranteed line item, called the **EDA price**, was factored into the floor price in the AdX auction. Setting the EDA price as the opportunity cost meant that just enough impressions would be set aside to ensure that guaranteed contracts would be fulfilled.[187] If Google's

[185] Comms Doc, "Enhanced Dynamic Allocation" (Nov. 6, 2017), GOOG-DOJ-06885161, at -161 ("Generally availability roll-out began on 3/3/2014.").

[186] *See* Google, "Delivery basics[:] Ad competition with dynamic allocation," Google Ad Manager Help (accessed Jan. 8, 2024), https://support.google.com/admanager/answer/3721872?hl=en ("The guaranteed line item competes using a temporary CPM or 'opportunity cost' that Ad Manager calculates automatically.").

[187] *See* Comms Doc, "Enhanced Dynamic Allocation" (Nov. 6, 2017), GOOG-DOJ-06885161, at -168 ("Will reservation delivery be affected? Reservation delivery should not be affected. Optimizing revenue while still honoring reservations is the most important goal of this optimization and we've done extensive testing to validate that it works."); Design Doc, "Uniform Treatment for DFP Remnant and AdX under EDA" (Apr. 2019),

estimates were exactly correct, remnant demand would buy exactly those impressions for which it was willing to pay the most—all those with remnant bids above the EDA price—and the remaining impressions would be assigned to guaranteed contracts, fulfilling those contracts perfectly. This combination both increases the number of impressions sold and maximizes publisher revenues. EDA also included adaptive procedures to guard against estimation errors. These procedures adjusted the EDA price dynamically over time if too many or too few impressions were being assigned to guaranteed contracts.[188]

113. EDA benefited publishers by increasing the revenues they received from remnant demand without jeopardizing guaranteed contracts. It also ensured that remnant demand advertisers were able to purchase impressions for which their values were the highest, increasing their match values. I discuss the benefits of EDA in detail in Section IX.

f) Emergence of Header Bidding and Integration with DFP

114. Beginning around 2014, publishers began to adopt **header bidding**, a technology that allows publishers to solicit and compare real-time bids from their favored sets of ad exchanges and other demand partners before calling an ad server.[189] To implement header

GOOG-AT-MDL-011687180, at -180 ("Enhanced Dynamic Allocation introduces competition between guaranteed reservations and other demand including AdX and DFP remnant reservations, by allowing AdX or DFP remnant to win over high priority DFP guaranteed reservations if it has a higher price than the opportunity cost (also called EDA price) set by us. The EDA price is calculated in such a way that the DFP guaranteed reservation's delivery goal would not be compromised.").

[188] *See* Google, "DFP and dynamic allocation," DoubleClick for Publishers Help (captured on Sep. 22, 2015), https://web.archive.org/web/20150922150140/https://support.google.com/dfp_premium/answer/3447903 ("The lower a line item's Satisfaction Index (SI) (that is, the more behind schedule it is), the higher the temporary CPM that's passed to Ad Exchange. Therefore, a standard line item that is behind schedule will win often enough to stay on pace to satisfy its goal and pacing settings.").

[189] *See, e.g.*, Presentation, "Demand Syndication" (Feb. 17, 2016), GOOG-DOJ-09459336, at -338 to -339; Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 13.

bidding, a publisher inserts a snippet of code in the header of its web page.[190] That code calls participating ad exchanges or other demand partners (either directly or via a server) to submit bids into an auction run on the browser or server, typically in a first-price format.[191] A publisher could directly allocate the impression to the demand source with the highest header bid, but many publishers sought to do better by integrating header bidding with their publisher ad server.[192] Integrating header bidding with DFP allowed publishers to enjoy the benefits of Enhanced Dynamic Allocation and other services on each impression.

115. While DFP was not designed to incorporate real-time bids from non-Google exchanges,[193] publishers incorporated header bidding into DFP by creating separate non-guaranteed line items for each bid value that each header bidding counterparty might provide (*e.g.*, separate line items for "Header Bidding Exchange A" at $1.00, $1.01, $1.02, etc.).[194] I will call those **header bidding line items** for the purpose of this report.

[190] *See* Presentation, "Demand Syndication" (Feb. 17, 2016), GOOG-DOJ-09459336, at -338.

[191] *See* Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 13 ("These Header Bidding auctions are typically first-price auctions."). *See also* Presentation, "Header Bidding Observatory #1" (Jan. 2017), GOOG-DOJ-AT-01027937, at -943 ("[T]he browser code runs a 1P auction"); Prebid.org, "Prebid.js FAQ" (accessed Dec. 1, 2023), https://docs.prebid.org/dev-docs/faq.html ("Header Bidding is a first-price auction.").

[192] *See* Presentation, "Header Bidding Observatory #1" (Jan. 2017), GOOG-DOJ-AT-01027937, at -939 ("[redacted]% of LPS [Large Partner Solutions] publishers are using header [bidding] tags.").

[193] *See* Deposition of [redacted] at 71:18-21 (Aug. 12, 2021), GOOG-AT-MDL-007178292, at -363 ("So in the original design of the system, it was not designed to put exchanges in as line items. Line items are designed to represent direct deals or network deals."); Deposition of [redacted] at 50:5-20 (Nov. 6, 2020), GOOG-AT-MDL-007172126, at -176 ("Q: And why was using line items for realtime pricing a risk to Google's AdServer? A: The way the system was built is that line items were always intended to be reservations. There wasn't a concept of using them for realtime pricing. And so we had in mind that publishers would have, you know, possibly thousands of line items and the system was built to scale to that, but with using line items for realtime pricing, which is not what they were designed to be used for, there were ten, sometimes ten times, sometimes 100 times, sometimes 1,000 times more line items than the system was designed to support.").

[194] *See* Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 14 ("Up until at least December 2021, the winning bid from the Header Bidding auction was typically used to trigger a specific line item that the publisher had booked within Google's ad server (most commonly a remnant line item) […] "); Email from [redacted]

After receiving header bids, the publisher's header bidding code would call DFP with the impression and would "trigger" one of the header bidding line items, and, under Dynamic Allocation, the value CPM of that line item could set the floor price in the AdX auction. In that case, if no bid on AdX exceeded that floor price, the impression would be allocated to the header bidder.[195] The value CPMs of header bidding line items—as for all non-guaranteed line items—were determined by publishers, and thus could differ from the winning header bid (and therefore also from the payment the publisher expected to receive for the impression).[196] The huge number of new line items created as a result of publishers adopting header bidding led to a substantial increase in infrastructure costs for Google.[197]

116. In this way, if a publisher configured its website to use header bidding before it offered an impression to AdX, the highest AdX bidder could win an impression if its bid beat the value CPM of the header bidding line item that was triggered by the publisher after

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to [redacted], "Re: Ultraprio - Increase the ALI for Turner" (Sep. 26, 2018), GOOG-DOJ-11782962, at -962 ("[T]heir HB pricing granularity is in $.01 increments up to $12").

[195] Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶¶ 11 ("Under Dynamic Allocation, the Value CPM associated with the best eligible non-guaranteed line item could set the floor price in the AdX auction."), 14 ("[T]he Value CPM of that line item could represent the winning Header Bidding bid as a floor in the AdX auction (prior to September 2019) or as a competing bid in the Unified First Price Auction (from September 2019 onwards).").

[196] Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶¶ 14 ("Up until at least December 2021, the winning bid from the Header Bidding auction was typically used to trigger a specific line item that the publisher had booked within Google's ad server (most commonly a remnant line item), and as described above in paragraph 11, the Value CPM of that line item could represent the winning Header Bidding bid as a floor in the AdX auction (prior to September 2019) or as a competing bid in the Unified First Price Auction (from September 2019 onwards)."), 11 ("Some publishers set Value CPMs based on their estimates of what CPM a line item would likely generate (taking into account its historical performance) or based on a fixed price the publisher had negotiated with a particular remnant demand partner. Some publishers set Value CPMs higher than their estimates of what CPM a line item would likely generate to increase competitive pressure in the AdX auction or for other reasons.").

[197] *See* Presentation, "PRD/Strat review: Network health" (Jun. 22, 2017), GOOG-DOJ-06875572, at -589 ("Infra abuse a growing problem: [redacted]X increase in ALI [Active Line Items] since Apr 2016 […] Incremental [redacted]K ALIs (2X limit) increases serving cost by [redacted]% and variable infra cost by [redacted]%").

resolving its header bidding auction.[198] This so-called "**last look**" was not a Google program: it arose as a consequence of the way that some publishers integrated header bidding into DFP using the line item capabilities that DFP (like other publisher ad servers) supported at the time header bidding was introduced.[199] In Section X, I examine the so-called "last look" and show that it was not a source of advantage for Google, contrary to the allegations made by Plaintiffs.

117. Header bidding has benefits and costs for publishers. On the benefits side, header bidding could help publishers increase their online display advertising revenues by collecting more real-time bids for impressions. On the costs side, header bidding has at least four disadvantages. First, it is relatively complex to configure.[200] Second, it often increases page load latency.[201] Third, it makes it more complicated for advertisers to bid optimally because of the possibility of self-competition, where an advertiser drives up the price it pays by unknowingly bidding against itself for the same impression in multiple places.[202]

[198] Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 14.

[199] *See* Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 17 ("'[L]ast look' was not designed to give AdX an advantage when competing against Header Bidding. It was simply the result of the Header Bidding auction taking place before the AdX auction ran and the way that publishers configured Header Bidding line items to work with Dynamic Allocation.").

[200] One publisher described the time required to integrate an SSP with a leading header bidding wrapper as "20 hours of work" (versus Open Bidding's "20 minutes"). *See* Sarah Sluis, "Google Ad Manager Builds A Bridge To Prebid—But Don't Call It A Two-Way Street," AdExchanger (Apr. 27, 2022), https://www.adexchanger.com/platforms/google-ad-manager-builds-a-bridge-to-prebid-but-dont-call-it-a-two-way-street/. Another industry source compares header bidding to previous ad configurations: "It's not just a little more work, it's probably 100X as much work to traffic for most publishers," *See* Ad Ops Insider, "Header Bidding Explained Step-by-Step" (Jun. 8, 2015), https://www.adopsinsider.com/header-bidding/header-bidding-step-by-step/.

[201] Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 24. *See also* Vishveshwar Jatain, "Understanding Header Bidding And How To Leverage It," Forbes (Sep. 17, 2019), https://www.forbes.com/sites/forbescommunicationscouncil/2019/09/17/understanding-header-bidding-and-how-to-leverage-it/?sh=332097315c18("Client-side header bidding […] increased page latency because executing auctions takes bandwidth and computing resources."); Pachilakis, M., Papadopoulos, P., Markatos, E. P., & Kourtellis, N. (2019). No more chasing waterfalls: a measurement study of the header bidding ad-ecosystem. In *Proceedings of the Internet Measurement Conference* (pp. 280-293).

[202] *See* Presentation, "Optimal AdX in DFP setup: Best practices, and how to traffic RTA/RTP (header bidding) line items" (Sep. 24, 2015), GOOG-TEX-00000001, at -004 ("[H]eader bidding can make buyers bid against themselves

Fourth, there were reports of payment discrepancies between the bids of header bidding exchanges and eventual payments.[203] I discuss these benefits and costs of header bidding further in Sections X and XIII.

g) Open Bidding Allowed Non-Google Exchanges to Compete in a Unified Auction, Benefiting Publishers and Increasing Platform Thickness

118. Google began testing **Open Bidding** (formerly known as Exchange Bidding, demand syndication, and EBDA) in 2016 and officially launched it in April 2018. Open Bidding allowed publishers to run an auction using real-time bids from multiple ad exchanges, including AdX and competing ad exchanges, within GAM. Some employees described Open Bidding as Google's "answer to header bidding."[204] Open Bidding allows non-Google exchanges to compete for an impression in an "auction of auctions" in which bids from Authorized Buyers, DV360, Google Ads, and other remnant line items booked by publishers in GAM (which might include header bidding line items) compete head to head.

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running 2 auctions for every impression."); [redacted]

[203] Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 24 ("Header bidding is also not transparent because, although the publisher 'accepts' the impression at a certain price, the header bidder may not actually pay the sum indicated in its bid."); Presentation, "Header Bidding Observatory #1" (Jan. 2017), GOOG-DOJ-AT-01027937, at -955 ("A comparison of HB reports vs DFP reporting showed significant discrepancies [in revenue]"). *See also* James Curran, "Opinion[:] For Publishers, Header Bidding Discrepancies Can Outweigh Revenue Lift," AdExchanger (Jul. 8, 2016), https://www.adexchanger.com/the-sell-sider/publishers-header-bidding-discrepancies-can-outweigh-revenue-lift/ ("Publishers need to create a more realistic calculation of header bidding revenue by factoring discrepancies into their line-item valuations. Some header bidding solutions can cause up to a 50% discrepancy between the publisher ad server impression reports and the impression reports from the programmatic partner. That means a $2 CPM is really a $1 CPM once you account for the adjustments made by the exchange for viewability, verification and performance tracking.").

[204] Presentation, "Demand Syndication" (Feb. 17, 2016), GOOG-DOJ-09459336, at -337.

119. Publishers determine which demand sources are eligible to compete under Open Bidding using the GAM interface. Under Open Bidding, a publisher needs to establish a contractual relationship with an Open Bidding partner in order to allow it to compete for the publisher's impressions.[205] When an impression arrives for which Open Bidding is eligible, GAM sends a request to AdX and participating Open Bidding exchanges. The Open Bidding auction design changed several times during testing, as I discuss in detail in Section XIII.

120. The introduction of Open Bidding benefited publishers and thickened the Google online display advertising platform, by simplifying the process of integrating bids from multiple sources, including competing exchanges. Open Bidding is easier to configure and has lower latency than some header bidding alternatives, although many publishers continue to use header bidding exclusively or in combination with Open Bidding.[206] Among its advantages for publishers are simpler configuration and streamlined payments.[207] The introduction of Open Bidding also benefited some non-Google exchanges by reducing the

[205] Google, "Introduction to Open Bidding," Google Ad Manager Help (accessed Oct. 31, 2023), https://support.google.com/admanager/answer/7128453?hl=en("[B]efore a publisher can connect with an Open Bidding yield partner, the publisher must have an established contractual relationship with that partner.").

[206] For a comparison of Open Bidding and header bidding, see Comms Doc, "Open Bidding on Ad Manager (fka Exchange Bidding)" (Aug. 2019), GOOG-DOJ-15389438, at -440 to -441. For a comparison of timeouts, see Comms Doc, "RTB Timeouts" (Oct. 2019), GOOG-DOJ-15232606, at -609 ("Google's lower bid timeouts should have a slightly better user experience with lower latency"). For usage with header bidding, see Abhilasha, "The Ultimate Guide to Open Bidding for Publishers," headerbidding.co (Jul. 25, 2023), https://headerbidding.co/open-bidding-ultimate-guide/("[I]t is possible to run Open Bidding alongside Header Bidding."); George Levitte, "Improved header bidding support in Google Ad Manager," Google Ad Manager (Apr. 27, 2022), https://blog.google/products/admanager/improved-header-bidding-support-in-google-ad-manager/("[M]any [publishers use] a mix of header bidding and server-side solutions like Open Bidding").

[207] *See* Comms Doc, "Open Bidding on Ad Manager (fka Exchange Bidding)" (Aug. 2019), GOOG-DOJ-15389438, at -438 ("Eliminate operational inefficiencies such as line item complexity […] Easy to set up, view/analyze reports and unified payments").

publishers' costs of integrating with them, allowing them to sell additional impressions.[208] For example, OpenX reported that "[e]xisting OpenX publisher partners who enabled [Open Bidding] through the OpenX Exchange experienced an average 48% increase in programmatic revenue from OpenX."[209] In Section XIII, I discuss in detail the benefits of Open Bidding for publishers and competing exchanges.

h) Unified First Price Auction and Unified Pricing Rules

121. As discussed in Section III.C.4 above, most exchanges transitioned to first-price auctions between 2017 and 2019.[210] Heterogeneity in the auction formats used by exchanges during this period complicated the implementation of header bidding and Open Bidding, both of which combine the results of auctions on different exchanges that may use different auction rules to sell the same impression. One unfortunate result of this "auction of auctions" process is that the bidder with the highest bid did not necessarily win the impression.

[208] *See* Comms Doc, "Open Bidding on Ad Manager (fka Exchange Bidding)" (Aug. 2019), GOOG-DOJ-15389438, at -438 ("Easy to set up, view/analyze reports and unified payments […] Allows exchanges to respond to RTB call-outs […] Provides integrated reporting and billing for exchange bidding transactions won by 3rd party exchanges"), -441. *See also* Presentation, "Exchange Bidding Sell Side Update" (Jun. 14, 2018), GOOG-DOJ-11790760, at -775 (Table, "Win Rate of Total DFP Queries"; "EB Other Exchanges," [redacted]").

[209] OpenX, "Google & OpenX Release Study Showing Publisher Partners Experience 48% Revenue Lift Through Google Exchange Bidding Collaboration" (Feb. 15, 2018), https://www.openx.com/press-releases/google-openx-revenue-lift/.

[210] *See* Presentation, "DV360, Third Party Exchanges, and Outcome-Based Buying" (Oct. 16, 2018), GOOG-DOJ-12038253, at -267 (Figure: "Impression Share (US Ad Inventory)"; [redacted]. These figures would not include AdX's later transition to a first-price auction in 2019. *See also* Email from [redacted], "Re: Offering 1st price to publishers?" (Sep. 13, 2017) GOOG-DOJ-05272070, at -075 ("Other exchanges started the migration to 1st price auction recently arguing th[at] it is the best way to integrate it with HB.").

122. GAM transitioned to the **Unified First Price Auction (UFPA)** in 2019.[211] A Google employee described the reason for the transition to the first-price auction on GAM as follows:

> "Publishers typically use our platforms to work with a variety of demand sources, which used to compete under inconsistent rules, and passing through multiple intermediaries, each of which runs its own auction (some first-price, some second-price, and some apparently running strange hybrid mechanisms), potentially transforms bids, and collects a share of revenue. This led to market confusion and inefficiencies; the move to a unified first-price auction was an attempt to move to a simpler, more transparent and sustainable state, improving outcomes for publishers, advertisers, and other ecosystem participants. Of course, first-price auctions are not incentive-compatible, so this required both Google buyers and external buyers to modify bidding algorithms as well."[212]

Under the UFPA, all bidders—including AdX bidders, header bidders, and non-Google exchanges using Open Bidding—compete in the same first-price auction, with no so-called "last look." This change ensured that, for each impression, the winner in the UFPA would be the bidder with the highest bid. Google's buy-side tools implemented bid optimization programs on behalf of their advertiser customers to make it easier for them to bid optimally in the UFPA; there was no need for an advertiser to change its campaign

[211] Sam Cox, "Simplifying programmatic: first price auctions for Google Ad Manager," Google Ad Manager (Mar. 6, 2019), https://blog.google/products/admanager/simplifying-programmatic-first-price-auctions-google-ad-manager/("[I]n the coming months we'll start to transition publisher inventory to a unified first price auction for Google Ad Manager."); Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 37.

[212] Email from [redacted] to [redacted], "Fwd: Join Auction Brown Bag Series: (TODAY @ 12pm PT!)" (Nov. 15, 2019), GOOG-DOJ-AT-00070433, at -433.

parameters in response to the new auction format, as Google's tools did that automatically.[213] I discuss the transition to the UFPA further in Section XIII below.

123. GAM implemented **Unified Pricing Rules (UPR)** at the same time as introducing the UFPA.[214] Under UPR, publishers could set floor prices that varied by properties of the impression and characteristics of the advertiser, but not by the identity of the exchange or demand source of the bidder, ensuring equal treatment of AdX and non-Google SSPs.[215]

124. As I discuss in Section XIV, UPR benefited advertisers and buying tools bidding into multiple exchanges by making it easier for them to determine their bids on different exchanges. Without UPR, publishers could engage in **price-fishing**, which is a close cousin of multi-calling.[216] Price-fishing is a tactic in which some publishers would call the same bidders on different exchanges using different floor prices in an attempt to

[213] *See* Alchemist, discussed in Section IV.C.1.c below (for Google Ads), and Poirot's update for the UFPA, discussed in Section VII.D.4 (for DV360). *See also* Sam Cox, "Simplifying programmatic: first price auctions for Google Ad Manager," Google Ad Manager (Mar. 6, 2019), https://blog.google/products/admanager/simplifying-programmatic-first-price-auctions-google-ad-manager/ ("[A]dvertisers using Google Ads or Display & Video 360 do not need to take any action.").

[214] Jason Bigler, "An update on first price auctions for Google Ad Manager," Google Ad Manager (May 10, 2019), https://blog.google/products/admanager/update-first-price-auctions-google-ad-manager/("In addition to impacting how publishers are using floor price rules, changing to a first price auction in Ad Manager requires a change in how our rules function. […] That's why we released a new feature to all publishers globally, called unified pricing rules.").

[215] *See* Comms Doc, "Ad Manager Unified 1st Price Auction" (Sep. 27, 2019), GOOG-DOJ-09714662, at -665 ("Unified Pricing rules will not support the following functionalities that were present in Open Auction pricing rules: Buyer-specific floors: ability to set different floors for different buyers/bidders for a given inventory targeting […] publishers will still be able to: Set per-advertiser floors in Unified Pricing rules"); Google, "Unified pricing rules," Google Ad Manager Help (accessed Jun. 25, 2024), https://support.google.com/admanager/answer/9298008 ("Advertiser- and brand-specific pricing can be configured in unified pricing rules. They don't apply to remnant line items. Per-buyer and per-bidder pricing are not available."); Jason Bigler, "An update on first price auctions for Google Ad Manager," Google Ad Manager (May 10, 2019), https://blog.google/products/admanager/update-first-price-auctions-google-ad-manager/("To maintain a fair and transparent auction, these rules will be applied to all partners equally, and cannot be set for individual buying platforms.").

[216] The main difference between price-fishing and multi-calling is that price-fishing calls the same bidders on different exchanges (with different floor prices), while multi-calling calls the same bidders multiple times (with same or different floor prices). Both tactics can lead to a loss in surplus for an unsuspecting advertiser.

induce them to make unnecessarily high bids to win an impression. When publishers engage in price-fishing, bidders need to account for the possibility that the floor price quoted to them at one exchange may be higher than the floor for the same impression quoted to them on another exchange. That possibility adds costs (because more bids must be submitted) and makes bidding optimally more complicated (because a bidder's optimal bid on each exchange depends on the impression's floor prices on other exchanges). To protect themselves against the possibility that some publishers would price-fish, bidders might be incentivized to reduce their bids on all publishers' inventory, a response that would harm publishers (including those not engaged in price-fishing) and reduce efficiency. Thus, UPR prevented harmful externalities that could reduce the profits of advertisers and publishers alike.

4. Google Responded to Competition by Improving Its Products

125. Google's online display advertising products evolved over time in response to the emergence of new technologies, changes in the behavior of advertisers and publishers, and evolutions in the broader online display advertising ecosystem. I summarize the key changes in Figure 1 above, with buy-side technologies (Google Ads and DV360) below the timeline and sell-side technologies (DFP and AdX) above. Each of these changes improved efficiency or reduced the costs of participating in Google's online display advertising platform, benefiting advertisers, publishers, or both.

IV. GOOGLE ADS BIDDING PROGRAMS: PROMOTING SIMPLE BIDDING AND INCREASING SURPLUS FOR GOOGLE ADS ADVERTISERS

A. Overview

126. Since it started bidding on AdX in 2009,[217] Google Ads has updated its bidding program for the AdX auction several times, with each update designed to increase its profits and the surplus of its advertisers and to respond to changes in the strategies of publishers and other bidders. The following are the key evolutions:

a. Beginning before 2013, Google Ads submitted two bids for its advertisers in each AdX auction that were equal to the two highest values for the impression among its advertisers, adjusted for Google Ads' revenue share (hereinafter the "**two-bid policy**").[218] This two-bid policy was part of a simple, bidder-truthful auction for Google Ads advertisers.

b. In 2013, Google Ads introduced its **bid optimization** programs, **buy-side DRS** and later **Bernanke** to optimize its bidding on AdX and increase the value of impressions won by Google Ads advertisers.[219]

[217] Email from [redacted] to [redacted], "Re: [Adsense-eng-wat] [Adsense-eng] Re: [Ads-engdirs] Doubleclick Ad Exchange 2.0 - Launched!" (Sep. 19, 2009), GOOG-AT-MDL-010836318, at -318 to -319 (noting that "[t]he team has done a great job [with AdX 2.0 launch] […] to also go beyond in some important areas, e.g. […] Real Time Bidding, and of course integration with Adsense and Adwords.").

[218] Email from [redacted] to [redacted], "Re: GDN Dynamic Revshare launched today!" (Jan. 17, 2013), GOOG-DOJ-04306227, at -227 ("In this case, GDN first holds its own auction and submits the leading 2 bids to the AdX auction. Historically, GDN applied a 14% revshare to these bids and AdX applies a 20% sell-side revshare to all bids in their auction.").

[219] Email from [redacted] to [redacted], "Re: GDN Dynamic Revshare launched today!" (Jan. 16, 2013), GOOG-DOJ-04306227, at -227 ("Today we launched GDN Dynamic Revshare - a means for GDN to optimize the revshare we apply to AdX bids."); Launch Details Spreadsheet, Launch 106307 (Aug. 29, 2023), GOOG-AT-MDL-009644018, at cells C1, C2 ("Launch Date [...] 2013-11-11").

c. A 2015 update, **Global Bernanke**, increased the value of impressions won by Google Ads advertisers further by allowing the revenue share collected by Google Ads to vary across different publishers' inventory.[220]

d. In 2019, as AdX replaced its second-price auction with its Unified First Price Auction, Google Ads updated Bernanke for the revised auction pricing rule and called the new program **Alchemist**.[221]

My analysis of data on Google Ads advertisers' values for impressions shows that each of these bid optimization programs increased advertiser surplus for most Google Ads advertisers.

127. Plaintiffs' allegations about Google Ads' bidding programs are marred by their misunderstanding of the operation of these programs. In particular:

[220] Email from [redacted] to [redacted], "[Caqengleads] [Launch 133445] Global Bernanke (+$[redacted] revenue)" (May 21, 2015), GOOG-DOJ-15637938, at -938 ("Global Bernanke is an extension of project Bernanke in which GDN retains a 15% margin on AdX as a whole, while deviating from 15% on individual publishers.").

[221] Design Doc, "The Alchemist (AKA First Price Bernanke)" (Mar. 2019), GOOG-DOJ-14550102, at -102 ("Switching to First Price Auctions (FPA) makes GDN's first price bid optimization (for the winner of Adwords Mini Auctions) a unique problem in many ways: Because of the buy-side infrastructure (like HDMI) which was designed for bidding in a Second Price Auctions (SPA), we want to keep the mechanism truthful and individually rational from the buy-side's perspective and at the same time bid in sell-side's FPA. Furthermore, for each sell-side's publisher, we want to hit a specific (15%) margin. In this document we propose Alchemist: a simple mechanism (and a robust framework) that satisfies all these constraints while maximizing welfare and profit."); Declaration of N. Jayaram (Aug. 5, 2023), GOOG-AT-MDL-008842383, at ¶ 22 ("Google updated the Bernanke algorithms in 2019 to be compatible with the Unified First Price Auction. The updated version of Bernanke was sometimes referred to within Google as 'Alchemist.' The update was designed to maintain incentives for Google Ads advertisers to bid their true values even after Google transitioned to the Unified First Price Auction, while continuing to target a similar aggregate take rate for Google Ads as before the transition to the Unified First Price Auction.").

a. Plaintiffs and their experts allege that Bernanke made Google's ad exchange "essentially a third-price auction."[222] This claim and similar ones are wrong. Neither AdX nor Google Ads operated a third-price auction. Bernanke and its variations were buy-side optimizations for Google Ads that determined Google Ads' bids into AdX, and as bidding rules, they could never alter the AdX auction format.[223]

b. Plaintiffs and their experts allege that Google Ads' bid (and revenue share) optimization programs harmed its advertisers as well as publishers,[224] when, in fact, these programs increased the surplus of Google Ads advertisers *without* increasing Google Ads' revenue share, and Google's initial experiments found that the programs increased publisher revenues as well.

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[222] Expert Report of J. Chandler (Jun. 7, 2024), at ¶ 359 ("In Project Bernanke, participants believed they were in a second-price auction, but it was essentially a third-price auction"). *See also* Fourth Amended Complaint ¶ 299 ("[Bernanke] switched Google's AdX exchange from a second-price auction to a third-price auction.").

[223] *See, e.g.*, Deposition of [redacted] at 177:13-18 (Apr. 3, 2024) ("No, I wouldn't describe it that way. It's changing the -- its determining the bids that are sent into the AdX exchange auction, but it's not modifying the auction mechanism itself.").

[224] *See, e.g.*, Fourth Amended Complaint ¶¶ 313 ("Bernanke hurt publishers."), 315 ("Bernanke hurt advertisers, too."); Expert Report of J. Chandler (Jun. 7, 2024), at ¶¶ 355 ("Publishers were harmed [...]"), 356 ("Advertisers were harmed [...]"); Expert Report of J. Gans (Jun. 7, 2024), at Section VIII.B.3 ("Projects Bernanke and Global Bernanke harmed publishers by reducing the effectiveness of monetization of their inventory."), Section VIII.B.4 ("Bernanke harmed advertisers by overcharging them in low-demand auctions."); Expert Report of M. Weinberg (Jun. 7, 2024), at Section VIII.C.2 ("Projects Bernanke and Global Bernanke can lead to a reduction in ad quality as well as revenue per mille for publishers."), ¶ 259 ("Projects Bernanke and Global Bernanke result in lower ROI for GDN advertisers, because GDN advertisers spend more but without generating positive returns (by purchasing impressions at a price exactly equal to their willingness to pay).").

c. Plaintiffs and their experts also allege that Bernanke harmed non-Google buyers and exchanges,[225] when, in fact, they represented ordinary competition, [redacted][226]

d. Plaintiffs' experts further claim that Bernanke and its variants facilitated "collusion" among Google Ads advertisers,[227] but this is a mischaracterization. When Google Ads represented the highest bidder, the price paid by the winning Google Ads advertiser was always at least equal to the highest competing Google Ads bid, when a collusive outcome would entail a lower price. Moreover, and unlike collusion, Bernanke did not suppress output: it caused additional surplus-enhancing transactions to occur.

e. Plaintiffs' experts also speculate that Bernanke may have created inefficiency by "enabling lower-value advertisers to win impressions instead of higher-value

[225] Fourth Amended Complaint ¶¶ 589 ("As a result, advertisers bidding through DV360 or other non-Google buying tools are not competing equally with Google Ads for each impression in which Bernanke operates."), 316 ("Bernanke was exclusionary and successfully foreclosed competition in both the exchange and ad buying tool markets"); Expert Report of J. Chandler (Jun. 7, 2024), at ¶ 357 ("Other exchanges were harmed because AdX completed manipulated auctions that would not have been completed otherwise, and therefor [*sic*] would have been available to other auctions."); Expert Report of M. Weinberg (Jun. 7, 2024), at Section VIII.D.1 ("Under Projects Bernanke and Global Bernanke, GDN increased its revenue at the expense of non-Google ad-buying tools."), Section VIII.E.1 ("Projects Bernanke and Global Bernanke did not benefit GDN advertisers, but decreased win rates for advertisers using non-Google ad buying tools."); Expert Report of J. Gans (Jun. 7, 2024), at Section VIII.B.2 ("Bernanke harmed competition in the market for ad buying tools for small advertisers.").

[226] For example, [redacted]

[227] Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 233.

ones,"[228] but that theory is not supported by evidence or detailed analysis. For context, many non-Google buying tools submitted just a single bid into the AdX auction,[229] which can incentivize an advertiser using such a tool to submit a bid *higher* than its true value for the impression. Without a program like Bernanke, Google Ads advertisers would have been disadvantaged relative to non-Google Ads advertisers, creating inefficient allocations.

f. Plaintiffs' experts also allege that Bernanke and its variants bestowed an unfair "informational advantage" that "subverted" competitive forces due to the program's confidentiality.[230] These claims, however, overlook the benefits of keeping bidding strategies confidential in auctions, which protects Google Ads' advertisers from exploitation by publishers and other bidders.

B. Google Ads' Two-Bid Policy for AdX

128. Prior to January 2013, Google Ads submitted a **high bid** and a **low bid** into AdX for each impression equal to the values of the highest-scoring advertiser and the second-highest-scoring advertiser in the Google Ads internal auction, adjusted for a fixed Google Ads revenue share (which was typically 14%, and so I assume this to be Google

[228] Expert Report of P. Pathak (Jun. 7, 2024), at ¶ 181. *See also* Expert Report of M. Weinberg (Jun. 7, 2024), at Section VIII.C.2 ("Project Bernanke and Global Bernanke can lead to a reduction in ad quality."). Professor Weinberg's arguments only follow "if GDN advertisers tend to display lower quality ads," *id.* at ¶ 247, but he offers no justification for why this presupposition is true. *See also* Expert Report of J. Gans (Jun. 7, 2024), at ¶ 759 ("Bernanke enables lower-quality ads to be transacted and displayed on publishers' properties.").

[229] Presentation, "Understanding the AdX Auction" (Oct. 2014), GOOG-DOJ-12443562, at -567 ("[O]ther bidders are allowed to [second-price themselves], but often do not").

[230] Expert Report of J. Gans (Jun. 7, 2024), at ¶¶ 717 ("The higher GDN win rate from the Bernanke program allowed Google to maintain a critical informational advantage over other market participants and, with that advantage, subvert the process of competition."), 725 ("Global Bernanke [...] meant that some publishers may end up paying more to Google but without knowledge of that [...] Thus, the first step in enabling competitive forces to work was subverted.").

Ads' revenue share in the remainder of this section).[231, 232] If the Google Ads high bid won the AdX auction, the impression would be assigned to the highest-scoring advertiser, and that advertiser would pay its threshold price, equal to the clearing price of the AdX second-price auction, plus the Google Ads revenue share.[233, 234] I call this combination of how bids were submitted and prices set the Google Ads "**two-bid policy**."

129. For example, suppose that Google Ads had two advertisers willing to pay $4.00 and $2.00, respectively, for an impression with a floor price of $1.00. Under the two-bid policy, it would submit to AdX a high bid of $3.44 and a low bid of $1.72, with each bid equal to its advertisers' values net of the 14% Google Ads revenue share. If the $3.44 bid from Google Ads was the highest bid on AdX, the Google Ads advertiser would win the second-price auction, and the auction's clearing price would be the larger of the Google Ads' low bid of $1.72 or the highest bid from another bidder on AdX. For example, if

[231] In practice, AdX allowed a bidder to quote a "minimum clearing price" in its bid, which was the minimum price it would pay if it won the second-price auction. There is no difference in effect between a minimum clearing price and a second submitted bid, so I do not distinguish the two elsewhere in this report. *See* Design Doc, "Call-out-Proxy: 1-bid, 2-bid, and min-bid" (Feb. 24, 2012), GOOG-DOJ-03366145, at -145 ("Engineering suggestion: Each ad-network transfers a single bid, with an added field: a minimum price that needs to be paid if its bid wins."); Launch Doc, "RPO Exemption Policy V2 Launch Doc" (Nov. 14, 2017), GOOG-DOJ-13212948, at -948 ("The current policy (b/18573816) exempts a buyer network on a specific ad query if we see either more than one open auction bid submitted by the network, or a single bid that specifies a minimum payment.").

[232] Email from [redacted] to [redacted], "Re: GDN Dynamic Revshare launched today!" (Jan. 17, 2013), GOOG-DOJ-04306227, at -227 ("In this case, GDN first holds its own auction and submits the leading 2 bids to the AdX auction. Historically, GDN applied a 14% revshare to these bids and AdX applies a 20% sell-side revshare to all bids in their auction.").

[233] "GDN Auction Overview" (Oct. 11, 2014), GOOG-AT-MDL-001094067, at -076 ("The auction price[:] After the winner is selected, the auction converts the cost to a price for each candidate. For example, to compute the price that a MaxCPC candidate must pay in the event of a click, we divide the total cost by the probability of a click: $CPC_i = Cost_i / (pCTR_i * \text{Position Normalize}_{[config, i]})$"), -082 ("AdX bills per impression. When GDN submits a CPC bid, we pay the publisher immediately based on eCPM but we charge our advertiser only if the user clicks the ad. In the logs, the cost_type for these impressions is CPC_TO_ CPM.").

[234] To formalize this mathematically, suppose that v_1 and v_2 are the largest and second-largest values among Google Ads advertisers, and let b_2 be the larger of the second-highest bid on AdX and the floor price on AdX. Under the two-bid policy, Google Ads would make a high bid of $0.86v_1$ and a low bid of $0.86v_2$. If Google Ads provided the winning bid in the AdX auction, it would be charged $p = \max(0.86v_2, b_2)$ and the winning Google Ads advertiser would be charged $p/0.86 = \max(v_2, b_2/0.86)$.

there was another bidder on AdX with a bid of $2.58, the clearing price of the AdX auction would be $2.58 and the winning Google Ads advertiser would be charged $3.00 (equal to $2.58 divided by 86%, to account for the 14% Google Ads revenue share).[235] On the other hand, if the second-highest bid on AdX was the Google Ads low bid of $1.72, the clearing price of the auction would be $1.72, and the winning Google Ads advertiser would be charged $2.00.

130. This two-bid policy had four important effects. *First*, it ensured that Google Ads received a fixed proportion of the revenue generated by the sale of each impression. *Second*, because it charged the advertiser a threshold price, it ensured that the combination of the Google Ads internal auction and the subsequent AdX auction was a bidder-truthful process. This meant that advertisers only needed to determine their values for impressions (or their other campaign goals), and could do no better than to allow Google Ads to choose bids on their behalf. *Third*, the two-bid policy resulted in a market-clearing price for both the advertiser and the publisher. *Finally*, it replicated the outcomes of direct bidding by Google Ads advertisers, in a sense I now formalize.

131. I define a **direct bidding** policy as follows. Under direct bidding:

a. each Google Ads advertiser independently submits a bid to Google Ads with access to the same technical expertise and the same historical information on impressions as Google Ads;

b. Google Ads deducts its revenue share from that bid; and

[235] In this section, to simplify the description of the two-bid policy, I put aside the fact that many Google Ads advertisers pay only when clicks/conversions occur. As I described in Paragraph 91 above, as long as Google's estimates of engagement rates are correct, the average price paid under the pay-per-outcome system is the same as the average impression price given the per-impression bids calculated by Google Ads.

c. for each advertiser, Google Ads submits the result of this calculation as a bid in the AdX auction, and charges a winning advertiser the clearing price of the AdX auction (plus the Google Ads revenue share).

By definition, under direct bidding, no advertiser's bid affects the bid submitted by any other advertiser. The two-bid policy replicates the outcomes that would result from direct bidding.[236]

C. Google Ads' Bid Optimization Programs: Buy-Side DRS, Bernanke, and Alchemist

132. While a two-bid policy maximizes advertiser surplus among all bidder-truthful bidding policies with the same fixed revenue share on each impression, Google Ads identified that it could further improve outcomes for both itself and its advertisers using a different bidding policy that varied its revenue share on an impression-by-impression basis. I call such a program that selects bids to maximize an objective a **bid optimization program** (also known as a buy-side **dynamic revenue sharing program** because, given the bidder's value, one can choose bids indirectly by varying the buying tool's revenue share). Before I describe the bid optimization programs introduced by Google Ads, I first extend the example from Paragraph 129 to show how a program that fixes its average revenue share across a pool of impressions can improve outcomes for Google Ads' customers, while simultaneously increasing Google Ads profits.

133. To illustrate this possibility, suppose that there are *two* impressions being sold on AdX like the ones from Paragraph 129, which have value $4.00 for Advertiser A on Google

[236] To see this, note that an advertiser bidding some amount under direct bidding has the same probability of winning and the same expected payment as under the two-bid policy, so that its optimal bids are the same under the two policies, leading to the same auction outcomes.

Ads and value $2.00 for Advertiser B on Google Ads. As I described above, under the Google Ads two-bid policy, Google Ads would calculate its bids by applying its fixed 14% revenue share to each impression, leading to it submitting bids of $3.44 and $1.72 on AdX. If the best other bid on AdX is $3.80 for the first impression and $1.00 for the second impression, then, under the two-bid policy, the Google Ads bids would only win the second impression at a clearing price of $1.72, which Google Ads would allocate to Advertiser A, charging $2.00, leading to total Google Ads advertiser surplus of $2.00 and Google Ads revenue of $0.28.[237] If instead Google Ads submitted a high bid of $4 and a low bid of $1.00 for both impressions, the Google Ads high bidder would win both impressions, with Google Ads paying $4.80 in total for the two impressions.[238] Google Ads could then charge $5.58 to Advertiser A for the two impressions, leading to increased advertiser surplus of $2.42 (vs. $2.00 under two-bids) and increased revenues for Google Ads of $0.78 (vs. $0.28 under two-bids), while maintaining an average Google Ads revenue share of 14%.[239]

134. In this simplified example in which publishers and bidders left their floor prices and bids unchanged, the decision by Google Ads to maintain its *average* revenue share across multiple impressions while allowing the share to vary for each individual impression

[237] To see this, note that for the first impression, the non-Google Ads bid of $3.80 is the highest, so the high Google Ads bid does not win that impression, but on the second impression, the Google Ads bid of $3.44 is the highest and its bid of $1.72 is the second-highest (and thus the auction's clearing price), so that Advertiser A wins the second impression and pays its threshold price of $2.00. Advertiser A's surplus is then its value minus the price it pays, here $4.00 - $2.00 = $2.00. Google Ads' revenue is $2.00 - $1.72 = $0.28.

[238] To see this, note that the Google Ads bid of $4 is the highest for both impressions, and in the first case, the second-highest bid is $3.80 (leading to a clearing price of $3.80), and in the second case, the second-highest bid is $1.00 (leading to a clearing price of $1.00). The total is then $3.80 + $1.00 = $4.80.

[239] Applying the 14% revenue share to the $4.80 cost of impressions to Google Ads gives $4.80 / 0.86, which is approximately $5.58. Advertiser A's surplus is then $8.00 - $5.58 = $2.42. Google Ads' revenue is then $5.58 - $4.80 = $0.78.

improved Google Ads' profits and the surplus of its advertisers. In general, for *any* fixed set of bids chosen by advertisers and floor prices chosen by publishers, advertisers can benefit from a program that averages revenue shares over a pool of impressions, without changing the overall average revenue share. While in this example, the increase in impressions won by Google Ads led to an equivalent loss in impressions won by other bidders on AdX, *this need not be true in general*: if the example were changed so that instead of the $3.80 being another advertiser's bid, it were the publisher floor price, then no other AdX bidder is harmed, an unsold impression is avoided, and publisher revenue is increased.

135. The foregoing discussion assumed that Google Ads knew its advertisers' values for the impressions and could choose its bids without influencing the incentives for advertisers to report their values for those impressions to Google Ads. It also did not consider the effects of its bidding policy on the floor prices chosen by publishers. As I have emphasized elsewhere, for accurate analysis of any bidding program or auction design, it is important to account for the incentives of both advertisers and publishers. Because these incentives depend fundamentally on each program's designs, I now discuss the evolution of Google Ads' bid optimization programs, before I analyze the effects of each program on advertisers and publishers.

1. The Evolution of Google Ads' Bid Optimization Programs

a) Buy-Side DRS: Reducing Revenue Shares to Win Additional Impressions

136. In January 2013, Google Ads introduced **Dynamic Revenue Share for AdWords** (**buy-side DRS**).[240, 241] Buy-side DRS was introduced partially in response to changes in bidding strategies of other bidders on AdX: a Google engineer observed at the time of its launch that "savvy exchange buyers (especially re-marketing players) are increasingly thinning their margins to win on volume."[242] Buy-side DRS allowed Google Ads to regain volume by reducing its revenue shares on some impressions to allow its advertisers to win additional impressions.[243] Unlike its later bid optimization programs, Google Ads did not increase its revenue share on other impressions.[244] Although this had the effect of slightly reducing Google Ads' overall revenue share, in experiments, that was more than offset by an increased volume of inventory won, so that the program led to an overall increase in profits for Google Ads.[245]

240 Email from [redacted] to [redacted], "Re: GDN Dynamic Revshare launched today!" (Jan. 17, 2013), GOOG-DOJ-04306227, at -227 ("Today we launched GDN Dynamic Revshare").

241 Note that Google had other programs with names like "dynamic revenue share," including on AdX ("sell-side DRS"). For clarity, I will refer to the Google Ads program as *buy-side* DRS.

242 Email from [redacted] to [redacted], "Re: GDN Dynamic Revshare launched today!" (Jan. 17, 2013), GOOG-DOJ-04306227, at -227.

243 Design Doc, "Dynamic Revshare for AdWords on AdX" (Jul. 13, 2012), GOOG-DOJ-13605152, at -152 ("Objective[:] Allow AdWords to dynamically adjust the revenue share it charges its bidders when competing in the AdX auction on a per-query basis […] The goal is to increase match rate of AdWords retargeting ads, while not undercutting Adwords-on-AdX revenue."); Presentation, "GDN Dynamic Revshare Launch" (Jan. 16, 2013), GOOG-DOJ-02854344, at -350 ("Launch Results […] queries +4.6% […] Adwords effective rev-share: 13.4% (control 14%)").

244 Design Doc, "Dynamic Revshare for AdWords on AdX" (Jul. 13, 2012), GOOG-DOJ-13605152, at -153 ("In cases with less competition AdWords can keep its current 14% revshare, and in cases where competition is high AdWords can choose to lower its margin.").

245 Email from [redacted] to [redacted], "Re: GDN Dynamic Revshare launched today!" (Jan. 17, 2013), GOOG-DOJ-04306227, at -227 ("As a result the leading bid is higher, and more competitive in the AdX auction - enabling GDN to win [redacted]% more impressions. While you might think that using a 0% revshare would eliminate GDN's profit, this is not the case because GDN is only charged the second price in the AdX auction. In fact,

137. Buy-side DRS worked as follows. Google Ads continued to submit two bids for each impression on AdX, but instead of determining the Google Ads high bid by deducting a fixed Google Ads revenue share from the highest scoring bidder's value, Google Ads deducted a *smaller* revenue share (as small as 0%) on some impressions.[246] This had the effect of increasing the Google Ads high bid on a subset of impressions, allowing its advertisers to win additional inventory. Google Ads continued to calculate advertiser payments based on the clearing price of the AdX auction, adjusted for the standard 14% revenue share, unless the result was higher than the advertiser's value for the impression, in which case the payment was capped at the bidder's value.[247, 248]

b) Project Bernanke: Winning More Impressions with a Fixed Average Revenue Share

138. In November 2013, Google Ads replaced buy-side DRS with a more comprehensive bid optimization program called **Project Bernanke**.[249] One of the motivations for Project Bernanke was to expand output by allowing Google Ads advertisers to purchase

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Dynamic Revshare increases GDN revenue by [redacted]% and profit by [redacted]% on AdX inventory."); Presentation, "GDN Dynamic Revshare Launch" (Jan. 16, 2013), GOOG-DOJ-02854344, at -348, -350.

[246] Email from [redacted] to [redacted], "Re: GDN Dynamic Revshare launched today!" (Jan. 17, 2013), GOOG-DOJ-04306227, at -227 ("Dynamic Revshare changes this logic by applying a revshare of 0% to the leading bid. (The 2nd bid still has the 14% revshare applied to it.)"); Presentation, "GDN Dynamic Revshare Launch" (Jan. 16, 2013), GOOG-DOJ-02854344, at -347.

[247] To formalize this mathematically, suppose that v_1 and v_2 are the largest and second-largest values among Google Ads advertisers, let b_2 be the larger of the second-highest bid on AdX and the floor price on AdX. Under buy-side DRS, Google Ads would make a high bid of v_1 for some subset of impressions and a low bid of $0.86v_2$. On those impressions, if its high bid won the AdX auction, it would be charged $p = \max(0.86v_2, b_2)$ and would charge a winning Google Ads advertiser $\min(\max(b_2/0.86, v_2), v_1)$.

[248] *See* Design Doc, "Dynamic Revshare for AdWords on AdX" (Jul. 13, 2012), GOOG-DOJ-13605152, at -153; Presentation, "GDN Dynamic Revshare Launch" (Jan. 16, 2013), GOOG-DOJ-02854344, at -349.

[249] Launch Details Spreadsheet, Launch 106307 (Aug. 29, 2023), GOOG-AT-MDL-009644018, at cells C1, C2 ("Launch Date [...] 2013-11-11").

otherwise unsold impressions, which was around half of all impressions at the time Bernanke was introduced.[250] At a high level, Bernanke achieved this objective by reducing the price that Google Ads paid for some impressions, allowing it to use the savings to bid more on other impressions, thus winning additional impressions for its advertisers and reducing the number of unsold impressions on AdX.[251] Project Bernanke accomplished this by modifying *both* of the bids that Google Ads submitted into the AdX second-price auction: it increased its high bid to win more impressions (as in buy-side DRS), but also decreased its low bid to reduce the AdX clearing price on some impressions.[252] Like buy-side DRS, Bernanke caused the Google Ads revenue share to vary on individual impressions, but Google Ads calibrated Bernanke to ensure that its overall revenue share remained at the 14% target.[253]

139. Project Bernanke used an optimization procedure to determine its bidding strategy into AdX. Under Project Bernanke, Google Ads chose **multipliers** for its two bids into AdX. The **high bid multiplier** led to high bids that were *higher* than those that Google Ads used under the two-bid policy, causing Google Ads advertisers to win additional impressions and reduce the number of unmatched impressions, increasing the publisher's

[250] "Bernanke experiment analysis" (Sep. 3, 2013), GOOG-DOJ-13469175, at -176 ("The current match rate on AdX (*i.e.*, queries where there is a winning ad) is about [redacted]%. The primary reason for the low match rate are the reserve prices set by the publisher, which need to be beat for an ad to win the auction.").

[251] Email from [redacted] to [redacted] "[Launch 106307] gTrade: Project Bernanke" (Oct. 18, 2013), GOOG-DOJ-14952787, at -787 ("GDN wins more auctions and generates more revenue at the same average 14% revshare; GDN's advertisers win more auctions and get greater click/conversion volume; and AdX publishers enjoy higher match rate and revenue.").

[252] "Bernanke experiment analysis" (Sep. 3, 2013), GOOG-DOJ-13469175, at -176 ("Project Bernanke involves reducing the second price and increasing the first price of the two bids submitted by GDN to the AdX auction in such a way that publishers receive fair payout (e.g. GDN margin remains constant) and GDN profit is maximized.").

[253] Email from [redacted] to [redacted] "[Launch 106307] gTrade: Project Bernanke" (Oct. 18, 2013), GOOG-DOJ-14952787, at -787 ("GDN wins more auctions and generates more revenue at the same average 14% revshare.").

revenue from those impressions and ones for which that bid was second-highest.[254] The **low bid multiplier** led to low bids that were *lower* than those that Google Ads used under the two-bid policy, lowering the AdX clearing price of certain impressions, namely, ones for which Google Ads would otherwise have submitted the two highest bids and both of those exceeded the auction's floor price.[255] The high and low bid adjustments were chosen separately for each publisher to *maximize* the total dollar value of impressions purchased via Google Ads while maintaining an overall Google Ads revenue share target (typically 14%), given the payment rules for Google Ads advertisers.[256]

140. Google Ads performed this optimization procedure weekly using data it obtained from its experiments conducted on a 1% sample of auctions in which it participated in the previous week.[257] It used that data to simulate auctions for different choices of bid multipliers and chose multipliers for each publisher's impressions that maximized the Bernanke objective function, subject to maintaining Google Ads' target average revenue

[254] "Bernanke experiment analysis" (Sep. 3, 2013), GOOG-DOJ-13469175, at -176 ("As mentioned above, project Bernanke involves reducing the second price and increasing the first price of the two bids submitted by GDN to the AdX auction in such a way that publishers receive fair payout and GDN profit is maximized. […] We pick various bid multipliers between 1 and 4 and evaluate whether GDN will win that query at each of these bid multipliers. On queries won by GDN at any bid multiplier, the payouts to the exchange and the publisher are then computed for various second bid reductions from 0 to 1."); Presentation, "Project Bernanke: Quantitative Easing on the AdExchange" (Oct. 21, 2013), GOOG-DOJ-12700489, at -493 ("Matched Queries [redacted]

[255] "Bernanke experiment analysis" (Sep. 3, 2013), GOOG-DOJ-13469175, at -175 to -176 ("As mentioned above, project Bernanke involves reducing the second price and increasing the first price of the two bids submitted by GDN to the AdX auction in such a way that publishers receive fair payout and GDN profit is maximized.").

[256] "Bernanke experiment analysis" (Sep. 3, 2013), GOOG-DOJ-13469175, at -175 ("This is done in such a way that GDN profit is maximized while also ensuring fair GDN payout to the exchange/ publisher. Here, fairness is defined as ensuring the desired margin on the GDN payout. For instance, for non-video requests, this implies retaining only $0.14 on average for every $1 revenue.").

[257] "Bernanke experiment analysis" (Sep. 3, 2013), GOOG-DOJ-13469175, at -176 ("In order to gather data for running the auction simulations, a 1% background experiment is run…").

share.[258] Google Ads also introduced an "online safety mechanism" to adjust the multiplier chosen in the case its overall revenue share drifted too far from the target.[259] Initially, the Google Ads revenue share target was applied per publisher.[260] In August 2015, Google Ads launched **Global Bernanke**, which applied the Google Ads revenue share target on average across publishers, while allowing the Google Ads revenue share target to vary to an extent for individual publishers.[261, 262] This additional flexibility in the choice of bid multipliers allowed Google Ads to further increase the total value of impressions won by its advertisers.

141. The optimization procedures described in Paragraph 140 used information of a kind that was also available to other buying tools. Contrary to the characterization by Plaintiffs, Google Ads did not "[rely] on inside information [...] using publishers' unencrypted ad

[258] "Bernanke experiment analysis" (Sep. 3, 2013), GOOG-DOJ-13469175, at -176 ("In order to gather data for running the auction simulations, a 1% background experiment is run where every top GDN bid is quadrupled and the second bid dropped. In this experiment, on queries GDN wins, it can be inferred that the second price is the price that GDN needs to beat in order to win the auction. Now, we can determine, if instead of quadrupling the bid, we could have, for instance, tripled the bid and still won this auction.").

[259] Presentation, "Project Bernanke: Quantitative Easing on the AdExchange" (Oct. 21, 2013), GOOG-DOJ-12700489, at -492 ("We implemented safety mechanism to fine-tune bid adjustments when margin drifts away from 14% in each supermixer task. [redacted]

[260] Presentation, "Project Bernanke: Exchange Profit Optimization" (May 20, 2013), GOOG-DOJ-13625417, at -422 ("14% margin across all pubs or per pub? We suggest per pub. Ensures 'fair' payout to each pub").

[261] Launch Details Spreadsheet, Launch 133445 (Aug. 25, 2023), GOOG-AT-MDL-009644112, at cells C2 (noting launch date of 2015-8-12), D2 ("Global Bernanke is an extension of project Bernanke in which GDN retains a 15% margin on AdX as a whole, while deviating from 15% on individual publishers.").

[262] At the same time, Google Ads updated [redacted]. *See* Presentation, "Beyond Bernanke" (Aug. 17, 2015), GOOG-DOJ-28385887, at -894 ("Global Bernanke solves slightly modified optimization problem: [redacted]).

server user IDs."[263] As a Google engineer noted, "[w]e respect GDN-AdX firewall: we only utilize GDN data to optimize bidding strategy. Any AdX buyer can do this."[264] In particular, access to an unencrypted publisher ID was not needed to implement any version of Bernanke: a bidder viewing only encrypted publisher IDs could still track spending by publisher (as in the version of Bernanke before Global Bernanke) using the encrypted ID. Publisher IDs are unnecessary to implement Global Bernanke.

142. In the first version of Bernanke, the prices that Google Ads charged a winning advertiser were determined as follows. On all impressions that it won on AdX at a price lower than the winning advertiser's net bid (after deducting Google Ads' standard 14% revenue share), the winning advertiser paid the larger of the second-highest Google Ads bid and the auction's clearing price (adjusted for the Google Ads revenue share).[265] This is the same price that the advertiser would pay without Bernanke. On the impressions that Google Ads won on AdX at a price that was higher than the winning advertiser's net bid, the winning advertiser paid its bid for the impression.[266] This pricing rule created an

[263] "Bernanke experiment analysis" (Sep. 3, 2013), GOOG-DOJ-13469175, at -176 ("It is important to note that in this entire process, we only use information about the GDN bid and the GDN price paid on queries won by GDN. In other words, we do not use any AdX buyer information.").

[264] Presentation, "Project Bernanke: Quantitative Easing on the Ad Exchange gTrade Update" (Oct. 3, 2013), GOOG-DOJ-06842351, at -359.

[265] Presentation, "Project Bernanke: Exchange Profit Optimization" (May 20, 2013), GOOG-DOJ-13625417, at -424 ("Queries GDN was already winning[:] GDN still wins these queries[,] Advertiser cost unchanged, based on second price auction […] Queries GDN wins because of increased bids[:] Advertiser pays first price (same as dynamic revshare)").

[266] To formalize this mathematically, suppose that v_1 and v_2 are the largest and second-largest values among Google Ads advertisers, and let b_2 be the larger of the second-highest bid on AdX and the floor price on AdX. Under Bernanke, Google's high bid was βv_1 (for some $\beta \geq 0.86$) and its low bid was αv_2 (with $\alpha \leq 0.86$). If Google Ads won the AdX auction, it would pay AdX $\max(b_2, \alpha v_2)$, and, under the original Bernanke pricing rule, the winning Google Ads advertiser would be charged $\min(\max(b_2/0.86, v_2), v_1)$.

incentive for advertisers to earn additional surplus on the extra impressions transacted by reducing their bids into Google Ads below their values.

143. In April 2016, Google Ads changed the Bernanke pricing rule for the majority of its advertisers (those using its automated bidding tools) to restore bidder-truthfulness.[267] It did so by charging a winning advertiser its threshold price—that is, an amount equal to the lowest value it could have reported while still winning the impression.[268] This resulted in a bidder-truthful process for Google Ads advertisers, making it simpler for them to configure their campaigns optimally.

c) Alchemist: Updating Bernanke to Optimize Bids for Advertisers in the Unified First Price Auction

144. In September 2019, when AdX completed its transition to the Unified First Price Auction, Bernanke was updated to be compatible with the first-price auction format.[269] The updated program was called **Alchemist**. As I discussed in Section III.C.3.b, in the first-price auction format, it is optimal for a profit-maximizing bidder to shade its bid below its value. Alchemist shades bids into AdX on behalf of advertisers using Google

[267] Launch Doc, "Don't First Price CO on AdX & AWBID" (Apr. 6, 2016), GOOG-DOJ-AT-02467209, at -209 ("Launch has two parts: 1) Do not first-price conversion optimizer ads on AWBID and AdX. Instead charge the minimum price needed to win the query. No change for non-CO ads."); Email from [redacted] to [redacted], "UPCOMING LAUNCH - Please review: [Launch 150218] Removing first pricing in global Bernanke and AWBid DRS + tuning Bernanke thresholds" (Apr. 8, 2016), GOOG-DOJ-15730729, at -729; Presentation, "Auction Overview" (Dec. 2019), GOOG-DOJ-13979867, at -879 ("Preserving incentive compatibility […] Most spend on GDA is from auto bidding").

[268] To formalize this mathematically, suppose that v_1 and v_2 are the largest and second-largest values among Google Ads advertisers, and let b_2 be the larger of the second-highest bid on AdX and the floor price on AdX. Under Bernanke, Google's high bid was βv_1 (for some $\beta \geq 0.86$) and its low bid was αv_2 (with $\alpha \leq 0.86$). If Google Ads won the AdX auction, it would pay AdX $\max(b_2, \alpha v_2)$, and, under Bernanke with the threshold pricing rule, the winning Google Ads advertiser would be charged $\max(b_2/\beta, v_2)$.

[269] Declaration of N. Jayaram (Aug. 5, 2023), GOOG-AT-MDL-008842383, at ¶ 22 ("Google updated the Bernanke algorithms in 2019 to be compatible with the Unified First Price Auction. The updated version of Bernanke was sometimes referred to within Google as 'Alchemist.'").

Ads. Those bids determine the prices paid by AdX to publishers, but Alchemist charges a winning advertiser its threshold price, which makes the auction process bidder-truthful for advertisers.[270] Like the earlier versions of Bernanke, Alchemist chooses Google Ads' bids in the AdX auction to maximize the total value of impressions won by Google Ads advertisers, subject to maintaining Google Ads' average revenue share and its threshold pricing rule for advertisers.[271] Unlike the original versions of Bernanke, Alchemist optimizes bids for a first-price auction format, rather than a second-price format, determining the optimal bids into the Unified First-Price Auction using experiments similar to those conducted by DV360 in the Poirot program, discussed in detail in Section VII below.[272] This means that under Alchemist, Google Ads shoulders the task of optimizing bids for the first-price auction format—a task that advertisers would otherwise need to attempt to do on their own—while eliminating any need for advertisers to strategize about their reporting to Google Ads.

2. Google Ads' Bid Optimization Programs Benefited Its Advertisers

145. In this section, I establish that each of Google Ads' bid optimization programs increased advertiser surplus for most of Google Ads' advertiser-customers, compared to their

[270] Declaration of N. Jayaram (Aug. 5, 2023), GOOG-AT-MDL-008842383, at ¶ 22 ("Since Google has transitioned to a Unified First Price Auction, the amount an advertiser pays Google Ads has been determined in generally the same way as before the transition, except that Google Ads began to use minimum-bid-to-win data to determine the amount that the advertiser would need to bid to win the AdX auction (factoring in the Google Ads margin).").

[271] Design Doc, "The Alchemist (AKA First Price Bernanke)" (Mar. 2019), GOOG-DOJ-14550102, at -102 [redacted]

[272] Design Doc, "GDN AdX First-Price Bidding Infrastructure" (Sep. 3, 2019), GOOG-DOJ-15254730, at -735 [redacted]

surplus under direct bidding, as I defined in Paragraph 131 above. In doing so, I fully account for the incentives for publishers to change their floor prices and Google Ads advertisers to change their bids in response to the bid optimization programs. These incentives are overlooked in Plaintiffs' analyses of Project Bernanke.

146. I establish the effects of Google Ads' bid optimization programs on its advertisers in three logical steps. *First*, I consider the effect of each program on advertiser surplus, supposing that the behavior of publishers and Google Ads advertisers remains unchanged by each program. *Second*, I account for the incentive effect of each program on the bids chosen by Google Ads advertisers and show that those effects can only further increase the surplus of Google Ads advertisers. *Third*, I account for the incentives for publishers to increase floor prices, which would tend to offset the increase in advertiser surplus obtained in the first two steps. I use a combination of economic theory and empirical analysis to establish that, for any such program allowing Google Ads advertisers to win more impressions, and even after accounting for publishers' responses, the net effect on Google Ads advertiser surplus (which depends not only on the number of impressions won, but also the prices paid) is positive. Finally, I discuss Google's experimental evidence relating to its bid optimization programs, which support these same conclusions.

a) Fixing Bids and Floor Prices, Each Bid Optimization Program Increased Advertiser Surplus

147. As I have discussed in Section IV.B above, the Google Ads two-bid policy replicated the outcomes of direct bidding and was bidder-truthful, which means that in any single auction, each Google Ads advertiser was incentivized to report its true value for an

impression. I compare outcomes under the various Google Ads bid optimization programs to those that would be obtained under direct bidding, supposing that the behavior of Google Ads advertisers, publishers and other bidders on AdX was unchanged. The following are the effects of each program:

a. *Buy-side DRS, Bernanke,* and *Global Bernanke with its original pricing rule*: These programs all increased the Google Ads high bid into AdX, so that if publishers and other bidders do not change their behavior, advertisers using Google Ads would win all the impressions that they would have won under the two-bid policy and also additional impressions. Under all three programs, for all impressions that Google Ads advertisers would have won in the absence of the bid optimization program, their payments were unchanged, while on the new impressions won as a result of the bid optimization programs, they would pay no more than their values. Overall, this could not reduce the surplus earned by advertisers.[273]

b. *Global Bernanke with a threshold pricing rule* and *Alchemist*: Fixing the behavior of publishers and other bidders, on the impressions that a Google Ads advertiser

[273] Note that the logic for Bernanke must be modified slightly for advertisers using automated bidding strategies involving budgets (because if the bids submitted by Google Ads to AdX were unchanged for those advertisers after Bernanke was introduced, the additional impressions won at a price equal to the bid would reduce the budget, without increasing the advertiser's surplus, and potentially reduce the advertiser's ability to win impressions it would have won in the absence of Bernanke). But Bernanke still benefits such advertisers because—if advertisers do not change their campaign objectives—the automated bidding program could choose a value for each impression leading to the same *net bid* with Bernanke as without it, which would lead to no change in impressions bought or prices (and thus no change in the advertiser's surplus). This means that the *optimal* choices of per-impression value chosen by the automated bidding tool can only lead to an increase in the advertiser's campaign objective, and any change in campaign objectives by a rational advertiser could only *further* increase the advertiser's benefits.

On the other hand, buy-side DRS was not applied to budget-constrained advertisers, so that any additional impressions won as a result of buy-side DRS did not reduce the advertiser's ability to win its existing impressions. *See* Design Doc, "Including Budget Constrained Ads in Bernanke" (Jun. 3, 2015), GOOG-AT-MDL-004555239, at -239 ("Originally, with DRS, we did not include budget constrained ads […]").

would have won in the absence of these programs, the effect of the program is to lower the thresholds that the advertiser must bid to win, and hence to reduce the prices the winning bidder pays, so the surplus it earns on each such impression cannot fall. For any additional impressions the advertiser wins as a consequence of the bid optimization program, the threshold price is never greater than the advertiser's bid, so the additional surplus from those impressions must be positive. This implies that the advertiser earns more surplus with those programs than without them. These programs both have the additional advantage of incentivizing advertisers to bid their value for an impression, making it easier for advertisers to report their campaign objectives to Google Ads, reducing transaction costs for advertisers.

b) If Google Ads Advertisers Re-Optimize Their Bids While Publisher Floors Remain Constant, Advertiser Surplus Can Only Increase Further

148. Under buy-side DRS, Bernanke, and Global Bernanke with the original pricing rule, Google Ads advertisers sometimes paid the amounts they bid on some impressions, which created an incentive for advertisers to lower their bids to increase their surplus on the impressions they won. In contrast, Bernanke with threshold pricing and Alchemist both incentivize advertisers to bid their value for an impression. But whatever an advertiser's *optimal* bids were after the introduction of the Google Ads bid optimization programs, these bids can only result in a *higher* expected surplus than the advertiser obtains under the bids it chooses under direct bidding (which I showed in Section IV.C.2.a was *higher* than the expected surplus it obtains in the absence of each optimization program). This means that—after incorporating any changes in Google Ads

advertisers' bids caused by those programs (but not changes in publishers' floor prices)—each program must have increased expected advertiser surplus.

c) Even Accounting for Likely Reactions by Publishers, Analysis of Google Ads Data Shows that Each Optimization Benefited Most Advertisers

149. Each of the Google Ads bid optimization programs increased some bids submitted by Google Ads for impressions. As a result, a revenue-maximizing publisher would be incentivized to set a higher floor price for each impression.[274] These higher floor prices could, in theory, offset the benefits of the optimization programs for Google Ads advertisers by increasing the prices paid on some impressions and reducing the probability that a Google Ads advertiser wins an impression (compared to the absence of a response from publishers). To assess the combined effects of the bid optimization programs and publishers' responses, I conducted a quantitative evaluation using the Google Ads Log-Level Dataset from January 2024.[275]

150. For my computations, I divided the Google Ads data into **slices**, each containing observations of advertiser values for impressions with the same publisher, inventory unit, and other observable characteristics. I study the [redacted] slices with sufficient data to analyze reliably: those with at least 100,000 bids and $1 of advertiser spend.[276] I provide further details about this dataset and the slices analyzed in the Technical Notes in Section XV.A.2.

[274] This follows since—from the perspective of the publisher—each bid optimization program lowers the overall costs of setting a higher floor price (*i.e.*, it is less likely that there will be no bidder that exceeds the floor price).

[275] Google Ads Log-Level Dataset (January 2024), GOOG-AT-EDTX-DATA-000000000 to -000258388.

[276] These slices were generated using [redacted]

151. I investigate the data by posing the following question: *is it possible that, in some of these slices, publishers could have adjusted their floor prices so that the combined effect of Google's bid optimization and the publisher's adjustment increased Google Ads' win rate without also increasing the surplus enjoyed by Google Ads' advertisers?* If the answer is no, then any Google Ads bid optimization program that increases its win rate in the AdX auction is necessarily also a program that benefits its advertisers.

152. In Theorem 1 in Section XV.A.1, I establish that the answer to the above question depends on the shape of the **distribution** of advertiser values for impressions in each slice. A distribution is a curve showing the proportion of time that an advertiser's value is less than any specified dollar amount. I identify a set of distributions—**the Decreasing Hazard Rate (DHR) distributions**—for which I can offer mathematical proof that if all the slices had DHR distributions, then the answer to the italicized question above is indeed "*no, it is not possible* (see Corollary 1 in Section XV.A.1)." I then plot the distributions of advertiser values from the real-world data for each slice and check how closely a DHR distribution **fits** each of those distributions.[277, 278]

153. The distributions in the Google Ads data fit *very closely* to DHR distributions. In Figure 3, I show the distributions in the real-world data and nearby **fitted DHR distributions** (blue and red, respectively) for two slices. The right panel is the slice (among the [redacted] slices) that is *least well-approximated* by a DHR distribution.[279] The left panel is the slice

[277] A distribution function F with density f has a decreasing hazard rate (DHR) if $f(x)/(1-F(x))$ is a decreasing function.

[278] These fits were calculated using code/gads_bid_optimization_fit.py in my supporting materials. The figures (including Figure 3) are saved in the code/figures directory, with file names prefixed by gads_bid_optimization.

[279] According to a measure of goodness-of-fit discussed in Section XV.A.2.

at the 2nd percentile of goodness-of-fit, so that for 98% of slices, the two curves fit more closely than those in the left panel. For the left panel, the difference between the distribution in the data and the fitted distribution is practically imperceptible: the fitted red curve is almost completely covered by the blue empirical distribution. Even for the right panel—the worst slice among thousands of slices in the data—the fit is still very good, but a small difference is visible between the blue empirical distribution and the red fitted DHR distribution.

Figure 3: Examples of Fitted Distributions At The 2 Percentile (Left) and

154. My results in Corollary 1 imply that, for any DHR distribution of advertiser values, any bid optimization program that increases Google Ads' win rate necessarily also increases advertiser surplus. The corresponding statement when the fit with DHR is close, but not perfect, is that if Google Ads' win rate increases noticeably, for example by 2%, then its advertisers must benefit.

155. In Theorem 1, I make the approximation quantitatively precise so that I can apply it to the actual observed distributions in the Google Ads data. I find that advertiser surplus necessarily increases for at least 95% of the data slices under any bid optimization program that, after accounting for publisher responses, added at least 2% to Google Ads' win rate for that slice.[280] Figure 4 summarizes a set of similar findings, with the horizontal axis corresponding to an increase in Google Ads' win rate and the vertical axis showing the corresponding proportion of slices for which my bound establishes that advertiser surplus must increase.[281] This figure shows that, if a Google Ads bid optimization program led to 2% more matched queries, then advertiser surplus would increase for more than 95% of slices. To put the 2% threshold in context, experiments conducted after the launch of Project Bernanke found that the *total* number of matched queries increased by around [redacted]%.[282]

[280] This result was generated usin [redacted].

[281] Note that my analysis does not imply that other slices of Google Ads advertisers experienced losses due to the bid optimization programs. The DHR condition is a sufficient *but not necessary* condition for increases in the advertiser surplus (given increases in Google Ads' win rates), and the approximations I obtain are not "tight," meaning it is possible that a *larger* proportion of slices also experienced benefits.

[282] "Bernanke experiment analysis" (Sep. 3, 2013), GOOG-DOJ-13469175, at -175.

Figure 4: Fraction of Slices in Which Advertiser Surplus Must Increase, as a Function of the Increase in Slice Win Rate

[redacted]

156. The main takeaway from Figure 4 is that, given the value distributions on nearly every slice, that any of Google Ads' bid optimization programs that noticeably increased the Google Ads win rate must have benefited the vast majority of Google Ads advertisers. In other words, for Project Bernanke, Global Bernanke, and Alchemist, Google Ads' incentives were closely aligned with those of its advertiser customers: *any benefits of these programs for Google Ads were accompanied by benefits for its advertisers*.

d) Evidence from Google's Documents and Experiments Support These Findings, and Suggest Benefits for Publishers

157. Google Ads conducted launch experiments related to its bid optimization programs that broadly support my findings and suggest additional benefits to publishers:[283]

a. *Buy-side DRS:* Google Ads estimated that buy-side DRS increased the volume of impressions won by Google Ads by [redacted]%, equivalent to around [redacted] additional impressions won each day, and that most of these would have gone unsold in the absence of buy-side DRS because publishers set floor prices too high for those impressions.[284] These additional transactions that cleared as a result of buy-side DRS increased overall efficiency. While Google Ads' overall revenue share was expected to drop from [redacted]% to [redacted]%, Google estimated at launch that buy-side DRS would increase Google Ads' total revenue by [redacted]%.[285] Later analysis suggested that buy-side DRS increased Google Ads' total spend on AdX by [redacted]% and led to a [redacted]% increase in publisher revenues.[286]

[283] Note that the theoretical effects of the bid optimization programs on publisher revenues are positive or ambiguous. Buy-side DRS led to higher bids from Google Ads (without decreasing any other bids), which could only benefit publishers. The theoretical effect of Bernanke and Global Bernanke on publisher revenue is ambiguous, because it lowered clearing prices for some impressions sold on AdX while increasing the prices of the extramarginal impressions it won. The theoretical effects of Alchemist on publisher revenue are also ambiguous.

[284] *See* Presentation, "GDN Dynamic Revshare Launch" (Jan. 16, 2013), GOOG-DOJ-02854344, at -348, -350 ("Adwords […] queries: [redacted]%"); Presentation, "Discussion on improving AdX & AdSense backfill" (Apr. 15, 2014), GOOG-DOJ-03876025, at -043 ("Added another [redacted] additional queries per day").

[285] *See* Email from [redacted] to [redacted], "Re: GDN Dynamic Revshare launched today!" (Jan. 17, 2013), GOOG-DOJ-04306227, at -227 ("Dynamic Revshare increases GDN revenue by [redacted]%"); Presentation, "GDN Dynamic Revshare Launch" (Jan. 16, 2013), GOOG-DOJ-02854344, at -348, -350 ("Adwords effective rev-share: [redacted]% (control [redacted]%)").

[286] Presentation, "Project Bernanke: Quantitative Easing on the Ad Exchange gTrade Update" (Oct. 3, 2013), GOOG-DOJ-06842351, at -357.

b. *Bernanke:* Pre-launch experiments found that Bernanke increased the total volume of matched queries on AdX by [redacted]% and increased total publisher revenues by [redacted]%, although these effects would have been felt heterogeneously among publishers.[287] Experiments conducted after the launch found that the total number of matched queries increased by around [redacted]%, as did the total payouts to publishers.[288] Only around [redacted]% of publishers, weighted by revenue, experienced reductions in payouts.[289] The number of clicks and conversions on the impressions won by Google Ads advertisers increased by [redacted]% and [redacted]%, respectively.[290] The updated program, Global Bernanke, further increased publisher payouts (by [redacted]%) and the volume of matched queries (by [redacted]%).[291]

c. *Alchemist:* I have not analyzed (nor am I presently aware of) experiments related to Alchemist, which was introduced at the same time as other large changes to the Google Ads display advertising platform (namely, the Unified First-Price Auction and UPR), making it difficult to identify the effect of Alchemist in isolation.

[287] Presentation, "Project Bernanke: Quantitative Easing on the AdExchange" (Oct. 21, 2013), GOOG-DOJ-12700489, at -493.

[288] "Bernanke experiment analysis" (Sep. 3, 2013), GOOG-DOJ-13469175, at -175.

[289] "Bernanke experiment analysis" (Sep. 3, 2013), GOOG-DOJ-13469175, at -180.

[290] "Bernanke experiment analysis" (Sep. 3, 2013), GOOG-DOJ-13469175, at -181.

[291] Email from [redacted] to [redacted], "[Caqengleads] [Launch 133445] Global Bernanke ([redacted] revenue)" (May 21, 2015), GOOG-DOJ-15637938, at -938 ("Match rate [redacted]% […] Publisher payout [redacted]%").

D. Responding to Plaintiffs' Allegations about Google Ads' Bid Optimization Programs

1. Bernanke Did Not Alter the AdX Auction Rule and Did Not Deceive Publishers or Advertisers

158. Plaintiffs and their experts allege that Bernanke altered the AdX auction format, claiming that "[w]hen Google Ads submitted the top two bids into AdX, second pricing itself, Project Bernanke worked to turn the second price auction into a third price auction."[292] This claim is a category error, because Bernanke is not an auction rule. As one senior Google engineer described, "[Bernanke] determin[es] the bids that are sent into the AdX exchange auction, but [it does] not modify[] the auction mechanism itself."[293] Google Ads is a *bidder* in the AdX auction and the bidding rules chosen by individual bidders in the auction do not affect the auction format. Neither Google Ads nor AdX *ever* operated a third-price auction. As a consequence, Google did not "deceive[] both publishers and advertisers by converting sealed second price auctions into third price auctions."[294]

159. Bernanke also did not cause Google to "deceive [publishers] into accepting decreased payments."[295] With Bernanke in place, publishers continued to be paid the clearing price of the AdX auction (net of the appropriate revenue share), as was the case prior to the launch of Google's bid optimization programs. Moreover, Google experiments found that its total payments to publishers *increased* overall as a result of Project Bernanke, as was

[292] Fourth Amended Complaint ¶ 552; Expert Report of J. Chandler (Jun. 7, 2024), at ¶ 359 ("In Project Bernanke, participants believed they were in a second-price auction, but it was essentially a third-price auction [...]").

[293] Deposition of [redacted] at 177:13-18 (Apr. 3, 2024) ("No, I wouldn't describe it that way. It's changing the -- it's determining the bids that are sent into the AdX exchange auction, but it's not modifying the auction mechanism itself.").

[294] Fourth Amended Complaint ¶ 560.

[295] Fourth Amended Complaint ¶ 560.

logically necessary for Google to benefit from increased revenues from a program that did not alter its average revenue share.[296]

160. Bernanke also did not "deceive [advertisers] about the price that they were paying to display their ad" and did not "harm[] [advertisers] each time they won an auction that Bernanke or its variations affected."[297] As I discussed in Section III.D.2, an advertiser on Google Ads did not generally pay for each advertisement Google Ads placed on its behalf: instead, Google Ads advertisers typically paid on a price-per-outcome basis. As a result, even before Project Bernanke was introduced, the price paid by a Google Ads advertiser for an "outcome" (*e.g.*, a click on its ad or a sale on its website) would be determined by the clearing price on AdX only *on average* across a pool of impressions. Bernanke worked by averaging not only prices paid to publishers but also *revenue shares* charged to advertisers across pools of impressions, so that—while Bernanke did increase the clearing price paid to publishers for some impressions—on average, advertisers benefited. As my empirical analysis above demonstrates, Bernanke did not "harm" advertisers, and any resulting increase in their win rate improved advertiser surplus for the vast majority of Google Ads advertisers.

[296] Email from [redacted] to [redacted], "[Launch 106307] gTrade: Project Bernanke" (Oct. 18, 2013), GOOG-DOJ-14952787, at -787.

[297] Fourth Amended Complaint ¶ 561.

2. Plaintiffs Omit or Mischaracterize the Benefits of Google Ads' Bid Optimization Programs for Advertisers

161. Plaintiffs and their experts claim that "Bernanke overcharged advertisers,"[298] and that it "harmed advertisers by manipulating and inflating their bids."[299] But Bernanke had two main effects: (1) it decreased the prices paid by Google Ads advertisers on some impressions (namely, those impressions on which Google Ads submitted the two highest bids on AdX), and (2) it used those savings to win additional impressions for Google Ads advertisers, while never charging those advertisers more than their value for the impression. As my empirical analysis in Section IV.C.2.c above shows, the combination of these effects was a benefit to advertisers: any Google Ads' bid optimization program that increased the win rates of Google Ads advertisers also increased advertiser surplus for the vast majority of Google Ads advertisers.

162. Plaintiffs further claim that "Bernanke could route [an advertiser's] bids to less relevant sites and audiences [...] increas[ing] the cost of the [advertiser's] campaign and lower[ing] her return on investment."[300] The first claim is plainly false. Bernanke never altered an advertiser's campaign nor changed what impressions it bid on. The second claim is also incorrect. By design, Bernanke *maximized* the value of impressions won by Google Ads advertisers subject to it.[301] My empirical analysis suggests that the vast

[298] Expert Report of J. Gans (Jun. 7, 2024), at ¶ 772.

[299] Fourth Amended Complaint ¶ 315. *See also* Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 12e ("Project Bernanke and Global Bernanke led to an increased win rate for GDN buyers (without improving GDN advertisers' payoffs)."); Expert Report of P. Pathak (Jun. 7, 2024), at ft. 223 ("Project Bernanke does not benefit Google Ads' advertisers").

[300] Fourth Amended Complaint ¶ 315.

[301] *See*"Bernanke experiment analysis" (Sep. 3, 2013), GOOG-DOJ-13469175, at -175 ("This is done in such a way that GDN profit is maximized while also ensuring fair GDN payout to the exchange/ publisher. Here, fairness is defined as ensuring the desired margin on the GDN payout. For instance, for non-video requests, this implies

majority of Google Ads advertisers must have benefited from Bernanke whenever Bernanke increased the advertisers' win rates.

3. Plaintiffs Ignore the Benefits of Google Ads' Bid Optimization Programs for Publishers

163. Plaintiffs and their experts claim that Bernanke and its variants harmed publishers.[302] But Plaintiffs overlook the fact that Bernanke was a *buy-side program* that benefited Google Ads advertisers. They also overlook experiments conducted after Bernanke's launch that found that total payouts to publishers increased by around [redacted]%,[303] and only around [redacted]% of publishers, weighted by revenue, experienced reductions in payouts.[304] And while some publishers may have lost revenue, Google estimated that the total payout to publishers increased by an additional [redacted]% under Global Bernanke.[305]

retaining only $0.14 on average for every $1 revenue."); Presentation, "Beyond Bernanke" (Aug. 17, 2015), GOOG-DOJ-28385887, at -894 ("Global Bernanke solves slightly modified optimization problem: [redacted]" [Emphasis in Original]).

[302] *See, e.g.*, Fourth Amended Complaint ¶ 313 ("Bernanke hurt publishers."); Expert Report of J. Gans (Jun. 7, 2024), at Section VIII.B.3 ("Projects Bernanke and Global Bernanke harmed publishers by reducing the effectiveness of monetization of their inventory."); Expert Report of M. Weinberg (Jun. 7, 2024), at Section VIII.C.2 ("Projects Bernanke and Global Bernanke can lead to a reduction in ad quality as well as revenue per mille for publishers.").

[303] "Bernanke experiment analysis" (Sep. 3, 2013), GOOG-DOJ-13469175, at -175.

[304] "Bernanke experiment analysis" (Sep. 3, 2013), GOOG-DOJ-13469175, at -180.

[305] Email from [redacted] to [redacted], "[Caqengleads] [Launch 133445] Global Bernanke [redacted] revenue)" (May 21, 2015), GOOG-DOJ-15637938, at -938 ("Match rate [redacted].

164. Plaintiffs' experts also claim that Global Bernanke reduced publishers' payouts.[306] As support, Professors Gans and Weinberg both cite an internal Google document reporting that some publishers experienced reduced revenue from Global Bernanke.[307] Plaintiffs' experts overlook that the document shows that nearly half of publishers benefited from Global Bernanke. While the other roughly half of publishers saw reduced revenues, those reductions were almost always modest, and even the publishers with the largest revenue reductions still earned more under Global Bernanke than they would have in the absence of any Bernanke program.[308] Combining the effects on both groups, Global Bernanke's total effect on publishers was positive—a [redacted]% increase in payouts.[309] Moreover, Plaintiffs' experts ignore the benefits for Google Ads advertisers described in that same document: the win rate of Google Ads advertisers increased by [redacted]%.[310]

165. Plaintiffs also claim that Bernanke "restricted publisher choice."[311] They argue that "many publishers chose to set higher floors for Google Ads than other demand sources [...] But Bernanke overrode that choice, allowing Google buyers to win at the expense of

[306] Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 246 ("In a Project Global Bernanke strategy document, describing an experiment on 10% of the traffic, Google states that [redacted]% of publishers saw decreased revenues under Project Global Bernanke as compared to Project Bernanke, and [redacted]% of publishers saw a decrease between 5 and 10%."); Expert Report of J. Gans (Jun. 7, 2024), at ¶ 767 ("Results of the Global Bernanke experiment show the payout impact breakdown for all publishers. These results show that [redacted]% of publisher payout is negatively impacted by Global Bernanke, with [redacted]% of payout decreasing beyond the 10% margin constraint because of Global Bernanke.").

[307] Launch Doc, "Global Bernanke" (Jul. 26, 2015), GOOG-DOJ-AT-02471194, at -196.

[308] Launch Doc, "Global Bernanke" (Jul. 26, 2015), GOOG-DOJ-AT-02471194, at -194 ("In the experiment, we do see that on occasions publishers do lose slightly more than [redacted]%. [...] However, most of these publishers still earn more than with no [B]ernanke (a future constraint might be to ensure that publishers always make more than they would with no Bernanke in any Bernanke related launch).").

[309] Launch Doc, "Global Bernanke" (Jul. 26, 2015), GOOG-DOJ-AT-02471194, at -196 ("Publisher payout from GDN [redacted]%.").

[310] Launch Doc, "Global Bernanke" (Jul. 26, 2015), GOOG-DOJ-AT-02471194, at -195 ("GDN win rate [redacted]%[.]").

[311] Fourth Amended Complaint ¶ 314.

non-Google buyers."[312] This is incorrect. In all cases in which publishers set higher floor prices for Google Ads and an increased bid from Bernanke caused a Google Ads advertiser to win the impression, the publisher was paid at least its floor price. If a publisher was unhappy with that outcome, it could always increase its floor price to Google Ads even further. Bernanke generally benefited publishers, as confirmed by Google's experiments.

166. Plaintiffs' experts also allege that Bernanke harmed publishers by increasing the number of "low-quality" ads winning AdX auctions.[313] Professors Gans and Pathak support their claim with anecdotal evidence from the [redacted],[314] citing a Google document in which a Google engineer comments that "[f]rom what I could tell, our auction optimizations (Bernanke) were responsible for [redacted]% of impressions in the [redacted] escalation."[315] It is not clear from that evidence alone how prevalent low-quality ads were and whether changes to Bernanke would affect their prevalence. Moreover, preventing the display of objectionable ads is primarily a filtering challenge rather than a problem associated with any single auction program. While a publisher that was unhappy with the selection of ads winning at one price floor could experiment with increasing its price floors to change the selection of ads, this may not be the most effective approach to addressing ad quality concerns because, with or without a program like Bernanke, it

[312] Fourth Amended Complaint ¶ 314.

[313] *See, e.g.*, Expert Report of J. Gans (Jun. 7, 2024), at ¶ 755 ("Bernanke harms publishers by inflating bids of low-quality ads that would not clear the publisher-set price floor.").

[314] Expert Report of J. Gans (Jun. 7, 2024), at ¶ 760 ("Specifically, they note that Bernanke overrode [redacted] floor prices for [redacted]% of the problematic impressions that led to this issue."); Expert Report of P. Pathak (Jun. 7, 2024), at ¶ 166 ("In 2017, Google noted in an internal strategy document that its Bernanke auction optimization '[was] responsible for [redacted]% of impressions in the [redacted] escalation.'").

[315] "Protecting Publishers from Objectionable Ads - Proposal" (May 2017), GOOG-TEX-00782851, at -854.

would still be possible for low-quality ads to win with a sufficiently high bid. As another Google engineer noted, "cpm floors are not the best way to be keeping these ads out."[316] Instead, the cited document identified a range of ways that Google could improve its filtering to avoid low quality ads.[317]

4. Plaintiffs Exaggerate Google Ads' Bid Optimization Programs' Impact on non-Google Buying Tools and Exchanges

167. Plaintiffs' experts repeatedly claim that Bernanke disadvantaged non-Google ad buying tools,[318] but these claims conflate harms to *competition* with effects on *competitors*. Other ad buying tools could and did implement bidding strategies with similar effects as Bernanke, by reducing or omitting the second-highest bid in a second-price auction or by increasing the highest bid.[319] These kinds of bidding programs, which confer significant benefits to advertiser-customers while also increasing a buying tool's profits and win rates, exemplify competition on the merits.

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[316] "Protecting Publishers from Objectionable Ads - Proposal" (May 2017), GOOG-TEX-00782851, at -854.

[317] "Protecting Publishers from Objectionable Ads - Proposal" (May 2017), GOOG-TEX-00782851, at -851 ("We propose to build a set of tools to help sensitive publishers minimize their exposure to objectionable ads while avoiding the revenue hit of the 'blunt force' blocks currently used for this purpose.").

[318] *See, e.g.*, Expert Report of P. Pathak (Jun. 7, 2024), at ¶ 180 ("These increases in the win rates for AdX and Google Ads are at the expense of non-Google ad exchanges and ad buying tools."); Expert Report of M. Weinberg (Jun. 7, 2024), at Section VIII.D.1 ("Under Projects Bernanke and Global Bernanke, GDN increased its revenue at the expense of non-Google ad buying tools"); Expert Report of J. Gans (Jun. 7, 2024), at Section VIII.B.2 ("Bernanke harmed competition in the market for ad buying tools for small advertisers.").

[319] *See, e.g.*, [redacted]

168. Plaintiffs and their experts also claim that Bernanke "manipulate[d]"[320] AdX auctions, and, as a consequence, Google Ads "won more AdX transactions and earned more revenue, all at the detriment of rival buying tools."[321] But these claims omit both the observation that other buying tools had incentives to create similar bid optimizations and the evidence [redacted].[322] It also ignores the fact that non-Google buying tools were submitting just a single bid into the AdX second-price auction,[323] and, as a result, advertisers using those tools may have been incentivized to submit bids higher than their values for the impression.[324] As a consequence, if Google did not pursue a program like Bernanke, its advertisers (who had incentives to bid their values) would have been at a disadvantage compared to advertisers using other buy-side tools (who had incentives to bid more than their values). Moreover, Bernanke had a significant expansionary effect on total output by decreasing the number of unsold

[320] Fourth Amended Complaint ¶ 589 ("Project Bernanke, still operates today to manipulate auction results [...] As a result, advertisers bidding through DV360 or other non-Google buying tools are not competing equally with Google Ads for each impression in which Bernanke operates."); Expert Report of J. Gans (Jun. 7, 2024), at ¶ 716 ("[Bernanke was t]he first major project that Google employed to manipulate auction items [...] affecting competition in the exchange market."); Expert Report of J. Chandler (Jun. 7, 2024), at ¶ 357 ("Other exchanges were harmed because AdX completed manipulated auctions [...]."); Expert Report of J. Andrien (Jun. 7, 2024), at ¶ 54 ("[U]nder Bernanke, GDN manipulates advertisers' bids before sending them to AdX and that Bernanke advantages GDN bidders over non-GDN bidders, counter to Google's representations of equal footing among all auction participants.").

[321] Expert Report of J. Gans (Jun. 7, 2024), at ¶ 750.

[322] *See, e.g.*, [redacted]

[323] Presentation, "Understanding the AdX Auction" (Oct. 2014), GOOG-DOJ-12443562, at -567 ("[O]ther bidders are allowed to [second-price themselves], but often do not").

[324] For example, consider a buying tool that submitted a single bid into the AdX second-price auction on behalf of a group of advertisers, with that bid equal to the highest value reported by the advertisers in that group. If the buying tool charged its advertiser customers the clearing price of the auction, then that policy would lower each advertiser's expected payment for any bid submitted (compared to a counterfactual policy of submitting two bids equal to the values of their two highest-value advertisers) because the second bid submitted by the buying tool can only increase the clearing price of the auction and thus the price charged to the advertiser. Thus, the result of the one-bid policy is a reduction in the expected price paid for each possible bid, which creates an incentive for an advertiser to report higher bids to the buying tool (higher even than its value for the impression) to try to win additional impressions at lower average prices.

impressions—in those cases (as Professor Gans noted[325]), Bernanke does not disadvantage non-Google buying tools.

5. Bernanke was Competitive, Not Collusive

169. Professor Weinberg's claim that Google Ads' Project Bernanke "can be understood as simultaneously facilitating the effects of collusion among GDN advertisers, without their knowledge"[326] is a mischaracterization of Project Bernanke, also repeated by other experts.[327]

170. Professor Weinberg's argument is wrong because Bernanke lacks the characteristic effects of collusion. *First*, when bidding rings participate in a second-price auction, a winning bidder in the ring would pay just enough to beat the bids submitted by other bidders outside of the conspiracy. But under Project Bernanke, a winning advertiser on Google Ads always paid a price at least as high as the second-highest Google Ads bid, which was often higher than the highest bid submitted by other buying tools. *Second*, collusion generally entails reduced output, but Bernanke was a bid-optimization program that increased the number of impressions sold.[328] *Third*, collusion typically harms sellers

[325] Expert Report of J. Gans (Jun. 7, 2024), at ¶ 742 ("Similarly, in the second possible scenario, Bernanke does not impact non-Google advertisers.").

[326] Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 233.

[327] *See, e.g.*, Expert Report of J. Andrien (Jun. 7, 2024), at ¶ 43 ("I understand that Project Bernanke and its subsequent iterations, Global Bernanke and First Price Bernanke, facilitated both the effects of collusion among Google Display Network ('GDN') advertisers without their knowledge") (citing Expert Report of M. Weinberg (Jun. 7, 2024), at Section 8). *See also* Expert Report of J. Chandler (Jun. 7, 2024), at ¶ 349 ("In Project Bernanke and a later iteration, Global Bernanke, Google manipulated auctions to increase how often the Google Display Network (GDN) won. For my understanding of this conduct and its basic steps, I partially rely on the expert report of Matthew Weinberg.").

[328] Email from [redacted] to [redacted], "[Launch 106307] gTrade: Project Bernanke" (Oct. 18, 2013), GOOG-DOJ-14952787, at -787 ("GDN wins more auctions and generates more revenue at the same average 14% revshare; GDN's advertisers win more auctions and get greater click/conversion volume; and AdX publishers enjoy higher match rate and revenue.").

in auctions, but Bernanke resulted in *higher revenues* for publishers, as confirmed by Google's experiments.[329]

171. In contrast to Professor Gans' claim that Bernanke "subvert[ed] the process of competition,"[330] Bernanke exemplifies the process of competition among bidding tools and led to benefits for advertisers. Bernanke *maximizes* advertiser returns while maintaining a fixed revenue share, so that *any* tool seeking to maximize advertiser returns while constraining its revenue share in a second–price auction would choose a bidding program similar to Bernanke.[331] Non-Google buying tools adopted similar programs to Bernanke, including omitting or reducing the second bids in the AdX auction[332] and [redacted][333]

[329] *See, e.g.*, "Bernanke experiment analysis" (Sep. 3, 2013), GOOG-DOJ-13469175, at -175 ("We see good trends in most important metrics. Matched queries, Google revenue, publisher payout increase by about [redacted]%.").

[330] Expert Report of J. Gans (Jun. 7, 2024), at ¶ 717.

[331] For any impression, the price paid to the publisher may be different from the price charged to the advertiser. Adjustments to the two highest bids it submits enables Google to affect both its win rate and its revenue share, increasing the first without distorting the second.

[332] Presentation, "Understanding the AdX Auction" (Oct. 2014), GOOG-DOJ-12443562, at -567 ("[O]ther bidders are allowed to [submit a second bid], but often do not").

[333] [redacted]

6. Confidentiality About Bidding Practices Is Standard, Benefited Google's Customers, and Did Not Impede Competition

172. Plaintiffs' experts allege that Bernanke's confidentiality "allowed Google to maintain a critical informational advantage over other market participants and, with that advantage, subvert the process of competition."[334] However, this claim overlooks the need to keep some bidding strategies confidential in auctions with other strategic participants. Protecting bidding strategies in that way prevents publishers and other bidders from exploiting their bidding information at the expense of lower returns for Google customers. It is also standard in the industry: as one Google employee noted, the introduction of Bernanke "is similar to other third party buyers changing their bidding behaviour which we never announce and is confidential to the buyer."[335] I am not aware of other buy-side tools that make their bidding algorithms publicly available. Indeed, in all my years of studying auctions, I am not aware of any situation where one bidder has been required to disclose its strategies. Doing so would put that bidder at a competitive disadvantage and discourage its participation, reducing auction thickness and lowering returns for sellers.

173. Plaintiffs further claim that "[the] lack of transparency around fees impede[d] other firms from [...] competing with Google by offering the same services."[336] Dr. Chandler goes further and states that Bernanke's "undisclosed Google rule changes [...] made it impossible for auction participants and competing exchanges to understand the rules that

[334] Expert Report of J. Gans (Jun. 7, 2024), at ¶ 717.

[335] "GDN buying change via Bernanke" (Nov. 1, 2013), GOOG-AT-MDL-003995286, at -286.

[336] Fourth Amended Complaint ¶ 351.

governed and applied to auctions run by Google, skewing decision-making and outcomes."[337] These statements are incorrect. Non-Google bidders in the AdX auction do not need all the details of how Google Ads computes its bids for AdX in order to optimize their own bidding strategies. Experimentation—a routine part of the bid optimization process in auctions—can discover optimal bids without access to detailed information about Google's bidding algorithm. Moreover, other buy-side tools implemented programs similar to Bernanke: for example, [redacted].[338] Similarly, [redacted][339]

174. Professor Gans also claims that publishers would be adversely affected by the confidential nature of Bernanke, because "by making pricing non-transparent, publishers would not be alert to any over-payments to Google and would not have the critical first step in being able to initiate a competitive response."[340] But publishers had access to the

[337] Expert Report of J. Chandler (Jun. 7, 2024), at ¶ 360.

[338] [redacted]

[339] [redacted]

[340] Expert Report of J. Gans (Jun. 7, 2024), at ¶ 771.

key data necessary to assess the performance of AdX: their total revenues from auctions on the platform. Moreover, Bernanke, as a Google Ads bidding program, did not change anything about the level of transparency on AdX, a supply-side tool. Publishers are not entitled to bidders' private biddings strategies, and indeed revealing them could be harmful to bidders' outcomes. Google engineers noted this concern with respect to Project Bernanke, worrying that sharing details about how advertiser values determined bids could "be used to harm buyers."[341]

7. Plaintiffs Incorrectly Claim that Google Ads' Bid Optimization Programs Relied on Alleged Advantages Possessed by Google

175. In their Complaint, Plaintiffs allege that Google Ads' bid optimization programs used "inside information to [...] inflate Google Ads' win rate"[342] but buy-side DRS and Bernanke used only data of a kind that was available to other bidders on AdX, namely, the results of experiments conducted on small sets of impressions to optimize bids.[343]

[341] Email from [redacted] to [redacted], "Re: Bid transparency" (Feb. 17, 2017), GOOG-DOJ-13550075, at -076 ("My understanding is that you are asking about whether/when we should agree to share AdWords bids with publishers. [...] With Bernanke boost, our bids do[] not represent a true valuation and can be used to harm buyers."), -075 to -076 ("Even in a 5% sample, publishers can see AdWords high bids due to Bernanke and sur[e]ly it causes more panic on their side that they do not get their fair share. [...] So pub sees that it gets only $[redacted] when AdWords valuation was [redacted] (Note that the real valuation was $1). They cry out louder that AdWords walked out by paying only 20% of their bid (Whereas we paid them [redacted]%). Then they try to become smarter by putting higher reserve price for AdWords ….").

[342] Fourth Amended Complaint ¶ 316.

[343] Presentation, "Project Bernanke: Quantitative Easing on the Ad Exchange gTrade Update" (Oct. 3, 2013), GOOG-DOJ-06842351, at -359 ("We respect GDN-AdX firewall: we only utilize GDN data to optimize bidding strategy. Any AdX buyer can do this.").

There were no barriers to non-Google bidders using experiments to optimize their own bidding strategies,[344] and other bidders did use experiments to optimize their bids.[345]

176. As I demonstrate by example in Paragraph 133, the principle of applying revenue shares on average across impressions (rather than a fixed revenue share on each impression) can benefit advertisers, even in a modest pool of impressions. Google Ads' implementation of Bernanke used experiments conducted on a relatively small sample of daily data (1%), suggesting that other bidders could have implemented similar programs. For example, other bidders could use a larger fraction of daily data, less frequent updates, or more advanced designs that used the existing volumes of data more effectively. Notably, Plaintiffs do not provide any evidence that Google's alleged advantages are so significant that other firms could not create their own bid optimization programs. Moreover, [redacted].[346]

[344] *See* "Bernanke experiment analysis" (Sep. 3, 2013), GOOG-DOJ-13469175, at -176 ("The optimal combination of first bid increase and second bid decrease for each publisher is estimated using AdX auction simulations. In order to gather data for running the auction simulations, a 1% background experiment is run where every top GDN bid is quadrupled and the second bid dropped. […] It is important to note that in this entire process, we only use information about the GDN bid and the GDN price paid on queries won by GDN. In other words, we do not use any AdX buyer information.").

[345] For instance, Verizon's DSP experimented to evaluate its own bid shading program. *See* Zhang, W., Kitts, B., Han, Y., Zhou, Z., Mao, T., He, H., Pan, S., Flores, A., Gultekin, S., & Weissman, T. (2021). Meow: A space-efficient nonparametric bid shading algorithm. In *Proceedings of the 27th ACM SIGKDD Conference on Knowledge Discovery & Data Mining* (pp. 3928-36), at 3933. *See also* Choi, H., Mela, C.F., Balseiro, S. R., & Leary, A. (2020). Online display advertising markets: A literature review and future directions. *Information Systems Research*, *31*(2), 556-575, at 562 ("To overcome the econometric issues and to better understand the value of ad spend, both advertisers and researchers are turning attention to randomized field experiments."), 566 ("The evolution of buying and selling practices in display advertising are tightly integrated with the development of intermediaries' enabling technologies (*e.g.*, data collection, data analysis, RTB, real-time ad serving, A/B testing and optimization tools). With such technologies, intermediaries can better match publishers' impressions (consumers) to more relevant advertisers.").

[346] *See, e.g.*, [redacted]

V. PROJECT BELL: GOOGLE ADS' RESPONSE TO THE HARMFUL PRACTICE OF MULTI-CALLING

A. Overview

177. In October 2016, Google Ads launched **Project Bell** to protect its advertisers from a publisher tactic known as **multi-calling**, in which publishers requested bids from AdX multiple times for the same impression.[347] If unaddressed, multi-calling would lower advertisers' profits and harm other platform participants.

178. In their Complaint, Plaintiffs allege that Project Bell affected publishers that do not "give preferential access to AdX,"[348] when, in fact, Bell affected only publishers that called AdX multiple times for the same impression, regardless of whether they partnered with competing exchanges.[349] Plaintiffs' experts do not make substantive allegations about Project Bell.

B. Multi-Calls Harm Advertisers, End Users, and Non-Multi-Calling Publishers

179. **Multi-calling** refers to a tactic in which a publisher (or a supply-side tool on its behalf) makes multiple calls to a demand source for the same impression.[350] In 2016, Google

[347] "Display Ads Quality Launches 2016 - Revenue OKR History" (Apr. 19, 2017), GOOG-AT-MDL-003465605, at tab "2016 Q4 Web & mApps," cells D46, J46 (reporting launch date of "2016-10-26"). *See also* Design Doc, "Multiple calls and non-second price auctions: detection and management" (Sep. 23, 2016), GOOG-DOJ-AT-02471119, at -119 ("The objective of this launch is to take steps towards protecting advertisers from price inflation tactics by publishers and exchanges. There are particularly two mechanisms that we try to tackle here (a) multiple call to adwords and (b) unclean auctions on AWBid.").

[348] Fourth Amended Complaint ¶ 311.

[349] Declaration of N. Jayaram (Aug. 5, 2023), GOOG-AT-MDL-008842383, at ¶ 16 ("Bell v.2 changed Google Ads' bidding behavior only for the publishers that were understood, based on internal experiments, to be calling AdX multiple times for the same potential ad opportunity ('multi-calling publishers').").

[350] A *call* is when a publisher requests that an exchange or DSP bid for an impression. In industry usage, *multi-calling* typically refers to a publisher calling an advertiser multiple times for the same impression. In this section, when I discuss multi-calling, I will focus on the case where a publisher calls AdX multiple times for an impression. Internally, Google also called such publishers "mediating publishers," but this term was *also* used for

found that around 10% of publishers (henceforth **multi-calling publishers**) were multi-calling AdX, leading to an increase in bid requests for Google Ads.[351] Other demand sources also reported a higher bid request volume due to multi-calls and adopted practices to deter those.[352] There are two main reasons that a publisher might choose to multi-call a demand source.

180. *First*, the publisher might hope to use multi-calling with different floor prices to make an unsuspecting advertiser pay more for an impression. This tactic is illustrated in Figure 5 (reproduced from a Google document), and I now describe it using an example of how this tactic can allow a publisher to extract additional revenue from advertisers. Suppose that a publisher knows that an AdX bidder's bid for an impression is $1 for 90% of impressions, and $10 for 10% of impressions (net of AdX's revenue share). However, the publisher does not know which impressions draw the higher bid of $10. If the publisher

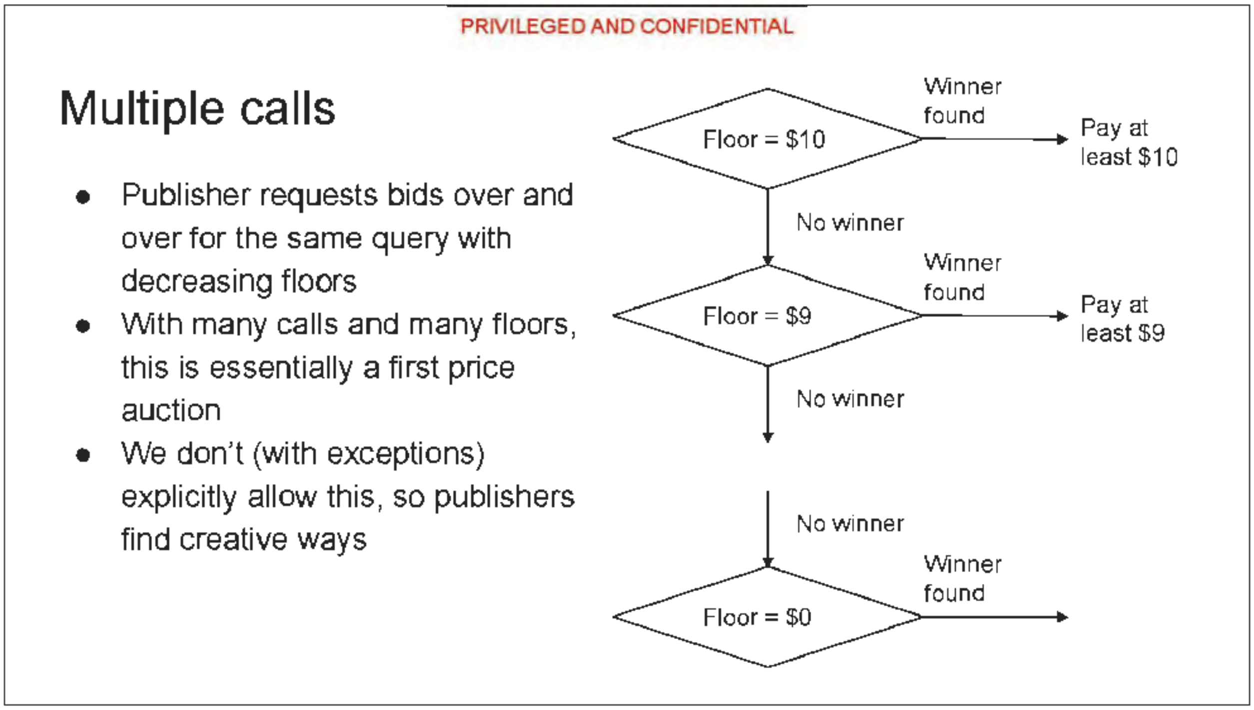
publishers who called multiple ad networks or exchanges, and so I avoid this term to avoid confusion. *See* Design Doc, "Multiple calls and non-second price auctions: detection and management" (Sep. 23, 2016), GOOG-DOJ-AT-02471119, at -119 to -120 ("In this doc, the term mediation refers to multiple calls.").

[351] Declaration of N. Jayaram (Aug. 5, 2023), GOOG-AT-MDL-008842383, at ¶¶ 12-13 ("Some publishers would call an ad exchange, such as AdX, multiple times for the same potential ad opportunity. For simplicity, I will refer to this practice as 'multi-calling.' […] Some publishers employing multi-calls would set a different floor price for each of the multiple calls made from a single ad exchange for the same potential ad opportunity. For example, a publisher could configure an AdX call with a floor price of $5 for a potential ad opportunity and a second AdX call with a floor price of $4.50 for the same potential ad opportunity."). *See also* Design Doc, "Multiple calls and non-second price auctions: detection and management" (Sep. 23, 2016), GOOG-DOJ-AT-02471119, at -120 ("About 10% of the domains on Adx fall in this category.").

[352] *See, e.g.*, Seb Joseph, "DSPs are cracking down on bid duplication," Digiday (May 12, 2020), https://digiday.com/media/dsps-are-cracking-down-on-bid-duplication/ ("Traffic spikes have caused increased costs in processing bid requests, giving already under pressure demand-side platforms extra economic incentive to squash bid duplication. MediaMath is building a new supply chain that doesn't include SSPs that sell duplicated impressions, for example. Last month, The Trade Desk gave all the SSPs it buys impressions from two weeks to stop sending it duplicated requests to take part in the same auction."); Sarah Sluis, "The Trade Desk suppresses bid duplication amid COVID-19 traffic surge," AdExchanger (Apr. 21, 2020), https://www.adexchanger.com/platforms/the-trade-desk-suppresses-bid-duplication-amid-covid-19-traffic-surge/ ("Publishers that slot the same six exchanges into multiple header-bidding auctions, such as Prebid, Google open bidding and Amazon Transparent Ad Marketplace, send 18 identical bid requests for the same piece of inventory to The Trade Desk. Currently, DSPs often begrudgingly evaluate them all, and find it hard to tell if the impression is exactly the same.").

offers the impression just once using AdX, then its optimal floor price is $1, selling all impressions, but earning no extra revenue on the impressions worth $10. Instead, as illustrated in the internal Google document reproduced as Figure 5, a multi-calling publisher might first call AdX with a floor price of $10, and then, only if the advertiser does not buy the impression on that first call, it could call AdX again with a lower floor price. If the bidder on AdX does not suspect that it will be multi-called and bids truthfully on each call, then it will pay higher prices—sometimes $10—due to these multi-calls. In this example, multi-calling allows the publisher to capture the entire surplus that the advertiser would otherwise earn in a second-price auction.

Figure 5: Multi-calling with decreasing floors.[353]



181. Multi-calling with descending floor prices can effectively convert a second-price auction into a **Dutch auction**, in which the seller starts with a high asking price and gradually reduces the price until a buyer is willing to accept (by offering a high enough bid). If a bidder does not adapt its bids to this multi-calling auction format and instead acts as if it is participating in a second-price auction, it ends up paying higher prices for impressions. Instead of bidding truthfully, the profit-maximizing response to multi-calling may require the advertiser to avoid bidding on some calls from the multi-calling publisher (namely, the ones with the highest floor prices). In the example in the previous paragraph, if the AdX advertiser who bids $10 into a second-price auction anticipates multi-calling, it should withhold its bid when the floor price is high and try to win the impression at a lower price when the publisher calls a second time. Deciding when to bid in the presence

[353] Presentation, "Exchange Buying Dynamics" (Aug. 22, 2017), GOOG-DOJ-12848608, at -616.

of multi-calling is complicated by the fact that the advertiser typically knows neither how many times the publisher will call it to bid on an impression, nor the floor prices of those calls, nor how other bidders may be responding to the publisher's multi-calling. For these reasons, determining a bidder's optimal bidding strategy in this setting resembles the problem of bidding optimally in a first-price auction: in both cases, the bidder needs to guess what other bidders are likely to be willing to pay in order to decide when and how much to bid on the publisher's impression. Because it forces bidders to strategize in a way similar to a first-price auction, Google engineers described this multi-calling strategy as "fishing for [a] first price."[354] But multi-calling is more complex and likely to result in worse outcomes than a first-price auction because the bidder must not only make forecasts about other bidders' behavior, but also the behavior of the publisher.

182. *Second,* the publisher may hope that, even with the same floor price, the bidder will change its bid for an impression if called multiple times. Bids for a single impression might change in relatively short intervals of time for a variety of reasons, including the budget pacing or frequency targets that advertisers often employ to govern their bidding.[355] For example, an advertiser may choose not to bid on every impression to avoid depleting its budget in a short period of time or to avoid presenting the same advertisement to the same end user in rapid succession. Multi-calling allows the publisher to undermine these campaign objectives by misrepresenting a single impression as

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[354] Email from [redacted] to [redacted], "[Launch 300192] Apps Bernanke for [redacted] (Jun. 18, 2019), GOOG-DOJ-15119015, at -015. While this quote refers to multi-calling in the context of app inventory, the general principle of "fishing for [a] first price" applies equally to other multi-call settings.

[355] For example, Google Ads offers a frequency capping feature. *See* Google, "Use frequency capping," Google Ads Help (accessed Jul. 24, 2024), https://support.google.com/google-ads/answer/6034106 ("Frequency capping allows you to limit the number of times ads appear to the same person.").

multiple ones. This can allow the publisher to extract higher bids on one of the calls, thwarting the advertiser's campaign goals and reducing efficiency. In response to this tactic, advertisers with frequency caps or budgets are incentivized to bid less or less frequently on impressions in order to achieve their campaign objectives.

183. The net effect is that multi-calling makes bidding more complex and harms efficiency. In the presence of multi-calling, advertisers are unable to tell whether multiple calls from a publisher represent a single advertising opportunity or multiple ones and cannot be sure whether the quoted floor price for an impression is really the lowest bid that the publisher will accept. They need to spend resources to detect and track multi-calling behaviors and adjust their bids strategically, which increases both transaction costs and the likelihood of bidding errors.[356] In the absence of a program that provides these services, the losses caused by multi-calling could lead advertisers to reduce their investments in online display advertising or switch to other buy-side tools that do not bid for impressions offered by multi-calling publishers.[357]

184. Aside from the direct harms caused to advertisers, multi-calling also creates externalities that harm other publishers and users. When advertisers are unsure about which publishers are multi-calling or which calls are duplicates, they are incentivized to reduce their bids into *all* auctions to lower the possible harms of multi-calling. That can reduce efficiency,

[356] *See* Sarah Sluis, "The Trade Desk suppresses bid duplication amid COVID-19 traffic surge," AdExchanger (Apr. 21, 2020), https://www.adexchanger.com/platforms/the-trade-desk-suppresses-bid-duplication-amid-covid-19-traffic-surge/ ("Publishers […] send 18 identical bid requests for the same piece of inventory to The Trade Desk. Currently, DSPs often begrudgingly evaluate them all, and find it hard to tell if the impression is exactly the same.").

[357] For example, The Trade Desk and MediaMath refused to work with sell-side platforms that made "duplicated requests" for the same impression. Seb Joseph, "DSPs are cracking down on bid duplication," Digiday (May 12, 2020), https://digiday.com/media/dsps-are-cracking-down-on-bid-duplication/.

including by decreasing the overall number of impressions sold, and reduce revenue for publishers, especially those that are not multi-calling. Furthermore, the additional bid requests created by multi-calling inevitably increase costs and latency, which harms all participants. Increased latency harms users, who face slower page load times; advertisers, whose ads may not be seen as a result of the delay; and publishers, whose websites suffer reduced traffic due to poorer user experience.[358, 359]

C. How Bell Identified Multi-Calling Publishers and Protected Advertisers

185. Project Bell identified multi-calling publishers by running experiments on subsets of each publisher's impressions, comparing the number of calls Google Ads received from the publisher if Google Ads bid very high on a subset of impressions (therefore always winning the impression on the first call from a multi-calling publisher) versus the number of calls it received if Google Ads bid very low (therefore always seeing all calls from a multi-calling publisher for an impression).[360] If there is no multi-calling, the number of calls should be the same for both treatments. At the time Bell was introduced, Google

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[358] Declaration of N. Jayaram (Aug. 5, 2023), GOOG-AT-MDL-008842383, at ¶ 15 ("In addition, multi-calling can increase ad latency because it takes time each time the ad exchange is called, an auction is run, and the ad exchange returns an ad.").

[359] Oded Poncz, "Traffic duplication might be a bigger problem than ad fraud," AdExchanger (Jan. 11, 2016), https://www.adexchanger.com/data-driven-thinking/traffic-duplication-might-even-be-a-bigger-problem-than-ad-fraud/ ("Another side effect of bid request duplication is that re-auctioning a bid takes time. In some cases, this could even become apparent to the end user. For example, if an end user is waiting for an interstitial ad to be shown upon opening an application, while behind the scenes there are a few auctions taking place for the same ad space, this will result in the user waiting considerably longer until they're able to access their content. This doubling of ad requests also adds to the overall latency in the ad ecosystem. If all this duplication means an ad takes five seconds to load, that makes for a poor consumer experience.").

[360] Design Doc, "Multiple calls and non-second price auctions: detection and management" (Sep. 23, 2016), GOOG-DOJ-AT-02471119, at -120 ("In summary, we run two experiments - one where we bid very high and the other where we bid very low. If the query count on Adx drops by over [redacted]% from the low to high bid experiments over a week period, we consider the domain to be a mediating domain.").

Ads' tests revealed that around [redacted]% of publishers on AdX were using multi-calls.[361] Contrary to Plaintiffs' allegations, Project Bell only affected publishers who made multiple calls *to AdX* for an impression. Making multiple calls to different exchanges before calling AdX did not trigger Bell.[362, 363]

186. Project Bell applied three treatments to protect Google Ads advertisers and discourage multi-calling by publishers.[364] Each treatment increased advertiser surplus by reducing the likelihood that Google Ads would bid above the highest floors chosen by multi-calling publishers.

187. The first treatment imposed a maximum, or **cap**, on bids to multi-calling publishers.[365] This helped protect Google Ads advertisers from paying too much to acquire these impressions. If an advertiser was aware of the publisher's multi-calling behavior, it could cap its own bid on impressions from that publisher, but it would be difficult for an

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[361] Design Doc, "Multiple calls and non-second price auctions: detection and management" (Sep. 23, 2016), GOOG-DOJ-AT-02471119, at -120 ("About [redacted]% of the domains on Adx fall in this category.").

[362] Declaration of N. Jayaram (Aug. 5, 2023), GOOG-AT-MDL-008842383, at ¶ 16 ("Bell v.2 changed Google Ads' bidding behavior only for the publishers that were understood, based on internal experiments, to be calling AdX multiple times for the same potential ad opportunity ('multi-calling publishers'). This launch did not directly change Google Ads' bidding behavior for any other publishers' ad opportunities. For example, Bell v.2 did not affect Google Ads bids on the inventory of publishers that called other exchanges before AdX, but did not call AdX multiple times, even if those other exchanges in turn called Google Ads.").

[363] I have reviewed documents (*e.g.*, Presentation, "Mediation detection and GDN bidding" (Mar. 2, 2015), GOOG-DOJ-06563186, at -194 to -201) in which Google considered applying these treatments to publishers who used "mediated single-calls," *i.e.*, publishers that called another exchange before AdX. I understand these plans were never implemented. *See* Declaration of N. Jayaram (Aug. 5, 2023), GOOG-AT-MDL-008842383, at ¶ 16.

[364] Presentation, "Mediation and non-second price auction: Detection and treatment" (Jun. 30, 2017), GOOG-DOJ-09875989, at -6008 to -6012.

[365] *See* Email from [redacted] to [redacted], "[Launch 188932] More aggressive treatment for mediation publishers" (Apr. 21, 2017), GOOG-DOJ-15208416, at -416 ("The only difference between this launch and [redacted] is the treatment for these mediation publishers in Adx. We use more aggressive treatment in this launch, [redacted]."). The level of this cap varied over time.

advertiser to detect that behavior and reduce bids accordingly.[366] Google Ads provided a service to its advertisers that would likely be more accurate and less costly than what many advertisers could implement on their own.

188. The second treatment was to disable Bernanke for multi-calling publishers.[367] By increasing Google Ads' high bids, Bernanke increased the variability of Google Ads' bids and thus the potential profitability of multi-calling for publishers.[368] Consequently, Bell disabled Bernanke for these publishers and reverted to submitting its two highest bids with a standard 14% revenue share to avoid incentivizing multi-calling from publishers and to protect Google Ads advertisers and non-multi-calling publishers.[369]

189. The third treatment was to stop buying from multi-calling publishers through AwBid, the Google Ads feature that allows advertisers to purchase some types of inventory through non-Google exchanges.[370] For a given impression, publishers making multiple calls to AdX might also make duplicated calls to other exchanges, which would be more difficult

[366] *See* Seb Joseph, "To reduce auction duplication, buyers start to enforce sellers.json," Digiday (Oct. 16, 2019), https://digiday.com/media/reduce-auction-duplication-buyers-start-enforce-sellers-json/ ("The impasse made it hard to spot duplicate bid requests from the same exchange for the same impressions."). *See also* Heymann, B. (2020). How to bid in unified second-price auctions when requests are duplicated. *Operations Research Letters*, *48*(4), 446-451. ("Bid request duplication is a challenging issue for display advertising buyers. […] We can picture the duplication problem this way: it is possible that several programmatic bidding agents of the same buyer receive a bid request without knowing whether the other agents have received a (duplicated) request and whether they are going to bid. Indeed, the time scale involved to answer the request is so short (less than 100 ms) that it can be technically impossible (or at least very challenging) for the buyer to synchronize the servers' behaviors.").

[367] Design Doc, "Multiple calls and non-second price auctions: detection and management" (Sep. 23, 2016), GOOG-DOJ-AT-02471119, at -119 ("Turn off Bernanke on mediating domains on Adx").

[368] *See* Declaration of N. Jayaram (Aug. 5, 2023), GOOG-AT-MDL-008842383, at ¶ 18 ("Disabling Bernanke on multi-calling publishers protected Google Ads and its advertisers by reducing the variance of Google Ads bids (making it less likely for Google Ads to bid more on behalf of its advertisers than would have been needed to win a potential ad opportunity in the absence of multi-calling).").

[369] *See* Presentation, "Mediation and non-second price auction: Detection and treatment" (Jun. 30, 2017), GOOG-DOJ-09875989, at -6009 ("Treatment 1: turn off Bernanke").

[370] Design Doc, "Multiple calls and non-second price auctions: detection and management" (Sep. 23, 2016), GOOG-DOJ-AT-02471119, at -119 ("Stop buying on these mediating domains through AWBid").

for Google to detect. If Google Ads continued to bid through AwBid on impressions sold by these multi-calling publishers, it ran the risk of being called additional times through separate exchanges for the same impression. In this case, buying inventory only through AdX (with the additional protections provided by the first two treatments) protected advertisers using AwBid from overpaying for inventory as a result of duplicated calls on other exchanges.

190. These three treatments by Project Bell were designed to protect Google Ads advertisers in the face of publisher multi-calls, avoiding reductions in their online display advertising surplus and avoiding any costs that advertisers would otherwise face to adapt their bids to multi-calling on their own.[371] Google communicated these changes to publishers and encouraged them to end their usage of multi-calls.[372]

191. In a pre-launch experiment, Project Bell was estimated to increase Google Ads advertisers' conversions per dollar spent by [redacted]%.[373] This estimate likely underestimated the benefits of the program to advertisers because the experimental window was unlikely to be long enough to capture the effect of publishers reducing their use of multi-calling. A later analysis found that Google's efforts to reduce multi-calling successfully reduced the

[371] *See* Email from [redacted] to [redacted], "[Launch 188932] More aggressive treatment for mediation publishers" (Apr. 21, 2017), GOOG-DOJ-15208416, at -416 ("These launches are to protect[] advertisers from price inflation tactics by publishers and exchanges. 1) Background: Some publishers send duplicate calls to adwords in order to obtain revenue as much as possible. This causes price inflation [for] advertisers.").

[372] Declaration of N. Jayaram (Aug. 5, 2023), GOOG-AT-MDL-008842383, at ¶ 21 ("To encourage them to reduce usage of multi-calls, Google communicated with multi-calling publishers that Google Ads would be making some changes to how it submitted bids in response to multi-calling.").

[373] "Display Ads Quality Launches 2016 - Revenue OKR History" (Apr. 19, 2017), GOOG-AT-MDL-003465605, at tab "2016 Q4 Web & mApps," at cell N46.

prevalence of multi-calling on AdX by up to [redacted]%.[374] The overall effect on publishers (and Google Ads spending) was expected to be approximately neutral because spending would be redistributed from multi-calling publishers to those who did not multi-call.[375]

192. The multi-calling problem was not specific to Google. Major demand sources including The Trade Desk and MediaMath refused to work with sell-side platforms that made "duplicated requests" for the same impression.[376] [redacted]"[377] Google Ads used a milder corrective measure to protect its advertisers and other publishers without completely eliminating valuable transaction opportunities.

D. Responding to Plaintiffs' and Their Experts' Allegations about Bell

193. Plaintiffs claim that, "[i]f a publisher does not give preferential access to AdX, then Bell would drop their auctions from second- to third-price auctions."[378] This is factually incorrect in three ways.

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[374] *See* "2018 Spring Perf - Tobias Maurer" (Mar. 26, 2018), GOOG-DOJ-05276941, at -944 (suggesting that Bell's impact on publisher behavior was substantial: "Launched Double call protections - together with sell-side commercialization reduced mediating pubs by 60%.").

[375] Comms Doc, "GDN Buying Change for Multiple Calls" (Jun. 7, 2017), GOOG-DOJ-10924698, at -698 ("Overall, the effect for Google is close to $0 as spend is redistributed from publishers doing multiple calls to those who don't."); Design Doc, "Multiple calls and non-second price auctions: detection and management" (Sep. 23, 2016), GOOG-DOJ-AT-02471119, at -122 ("Note from these numbers that these domains are net consumers of pool. So, turning Bernanke off here will cause this extra pool to be automatically reinvested on non-mediating domains.").

[376] Seb Joseph, "DSPs are cracking down on bid duplication," Digiday (May 12, 2020), https://digiday.com/media/dsps-are-cracking-down-on-bid-duplication/ ("MediaMath is building a new supply chain that doesn't include SSPs that sell duplicated impressions, for example. Last month, The Trade Desk gave all the SSPs it buys impressions from two weeks to stop sending it duplicated requests to take part in the same auction.").

[377] [redacted]

[378] Fourth Amended Complaint ¶ 311.

a. *First*, Bell was a Google Ads program determining how Google Ads bid into AdX, on which Google Ads was a *bidder*: it could not, as a result, change the auction format *for AdX*.

b. *Second*, Google Ads applied Bell's treatments to publishers only when they called AdX multiple times for the same impression, not when they contracted with a non-Google exchange. If a publisher called another exchange before AdX, but did not call AdX more than once for each impression, Project Bell would not affect that publisher.[379, 380] [redacted], Senior Director of Engineering at Google, has declared that "Bell v.2 did not affect Google Ads bids on the inventory of publishers that called other exchanges before AdX, but did not call AdX multiple times, even if those other exchanges in turn called Google Ads."[381]

c. *Third*, contrary to the Plaintiffs' claim that "Bell would drop their auctions from second- to third-price auctions," when Project Bell detected a multi-calling publisher, it *disabled* Bernanke and reverted to submitting its two highest bids with a standard 14% revenue share, which *increased* Google Ads' low bid. Neither Google Ads nor AdX ever used third-price auctions.

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379 *See* Comms Doc, "GDN Buying Change for Multiple Calls" (Jun. 7, 2017), GOOG-DOJ-10924698, at -700 ("Q: Are publishers who work with multiple exchanges impacted by this change? A: If GDN is called multiple times in series for a single query, as the result of any of the implementations mentioned above then the [publisher's] revenue may be negatively impacted."); Design Doc, "Multiple calls and non-second price auctions: detection and management" (Sep. 23, 2016), GOOG-DOJ-AT-02471119, at -119 ("we tackle multiple calls to Adwords on just Adx").

380 I have reviewed documents (*e.g.*, Presentation, "Mediation detection and GDN bidding" (Mar. 2, 2015), GOOG-DOJ-06563186, at -194 to -201) in which Google considered applying these treatments to publishers who used "mediated single-calls," in which publishers called another exchange before AdX. I understand these plans were never implemented. *See* Declaration of N. Jayaram (Aug. 5, 2023), GOOG-AT-MDL-008842383, at ¶ 16.

381 Declaration of N. Jayaram (Aug. 5, 2023), GOOG-AT-MDL-008842383, at ¶ 16.

194. None of the Plaintiffs' experts made substantial allegations about Project Bell.[382]

[382] Professor Hochstetler provides a brief description of the functioning of Project Bell (*see* Expert Report of J. Hochstetler (Jun. 7, 2024), at Section X.E). Professor Chandler mentions "Bell" in his Summary of Opinions, but his report contains no discussion of multi-calling or the details of a program resembling Project Bell v2, and so I have interpreted his allegations to apply to Global Bernanke, also known as Project Bell v1 internally at Google (*see* Expert Report of J. Chandler (Jun. 7, 2024), at ¶¶ 23, 341).

VI. PROJECT ELMO: MANAGING ADVERTISER BUDGETS WHILE DISINCENTIVIZING BID DUPLICATION AND MULTI-CALLING

A. Overview

195. Project Elmo is a budget management feature introduced by DV360 in November 2017[383] and Google Ads in November 2018.[384] Elmo ensures that Google's buy-side tools make consistent bids on behalf of an advertiser across all bid requests received for a given end user (as identified by a cookie) within each minute.[385] By bidding consistently on behalf of an advertiser for the same end user within each minute, Elmo helps advertisers control their bidding strategy and their rates of spending—for example, to avoid rapid depletion of their advertising budgets—and disincentives the harmful practices of multi-calling and bid duplication by publishers and exchanges.

196. Plaintiffs allege that Elmo was a strategy "to reduce spend on rival exchanges[,] represent[ing] a campaign to undermine the success of header bidding and starve rival exchanges of their primary source of demand."[386] In fact, Elmo was designed to ensure

[383] Launch Details Spreadsheet, Launch 209956 (Aug. 29, 2023), GOOG-AT-MDL-009644201, at cells C1, C4 ("Launch Date [...] 2017-11-29").

[384] Email from [redacted] to [redacted], "[Launch 205617] Cookie-based budget throttling for GDN advertisers" (Dec. 6, 2018), GOOG-AT-MDL-015521456, at -456 ("Launch Date [...] 2018-11-19"). *See also* Email from [redacted] to [redacted], "[Launch 205617] Cookie-based budget throttling for GDN advertisers" (Dec. 6, 2018), GOOG-DOJ-AT-01363996, at -996 (noting that launch had occurred).

[385] Email from [redacted] to [redacted]m, "[Launch 201914] DBM advertiser experiment for cookie-based throttling" (Aug. 29, 2017), GOOG-DOJ-13564564, at -564 ("Cookie-based throttling means keying the throttling decision on cookie instead of making an independent decision per query [...] ."); Design Document, "Cookie Budget Throttling" (Apr. 19, 2017), GOOG-DOJ-AT-02472888, at -889 ("The goal is to make budget throttling consistent across the multiple queries that result from mediation. [...] To solve this, we use cookie in the throttling decision. [...] Within each one-minute window, every query for the same delivery period on the same cookie gets the same throttling decision.").

[386] Fourth Amended Complaint ¶ 405 ("Taken together, Poirot, Elmo, and other strategies to reduce spend on rival exchanges represent a campaign to undermine the success of header bidding and starve rival exchanges of their primary source of demand.").

Google's budget management tools worked correctly for its advertiser customers.[387] By blocking the harmful effects of bid duplication, Elmo reduced spending on exchanges engaged in that practice and increased spending on exchanges that did not duplicate bids, regardless of whether those exchanges participated in header bidding.[388] None of the Plaintiffs' experts conduct substantive analysis of Project Elmo; nor do they provide supporting evidence for the allegations about its adverse effects.

B. Background: Budget Throttling As a Tool To Manage Advertiser Budgets

197. As discussed in Section III.D, advertisers using Google Ads and/or DV360 select campaign parameters that determine how those buy-side tools bid on their behalf for display advertising impressions.[389] One frequently used campaign parameter is a **budget**, which limits the total spending that the buy-side tool can make on behalf of the advertiser in a designated time period. In 2017, around the time of Elmo's launch on DV360, more than [redacted]% of DV360's advertiser customers were budget-constrained, meaning that the advertiser had selected a budget and that DV360 could have purchased more impressions if the advertiser had selected a higher budget.[390]

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[387] Design Document, "Cookie Budget Throttling" (Apr. 19, 2017), GOOG-DOJ-AT-02472888, at -889 ("The goal is to make budget throttling consistent across the multiple queries that result from mediation."); Presentation, "Bidding in Adversarial Auctions" (Nov. 27, 2017), GOOG-DOJ-05282625, at -633 ("We addressed the following problems for DBM in 2017: [...] Budget allocation where the same query is sent to the bidder multiple times (Elmo)[.]").

[388] Presentation, "Bidding in Adversarial Auctions" (Nov. 27, 2017), GOOG-DOJ-05282625, at -650 ("We see a significant drop in exchanges that exploited this mechanism and gains for the cleaner exchanges[.]").

[389] *See, e.g.*, Google, "Create a Display campaign," Google Ads Help (accessed Mar. 12, 2024), https://support.google.com/google-ads/answer/10759203; Google, "Create a campaign," Display & Video 360 Help (accessed Mar. 12, 2024), https://support.google.com/displayvideo/answer/7205081?hl=en.

[390] Presentation, "Bidding in Adversarial Auctions" (Nov. 27, 2017), GOOG-DOJ-05282625, at -647 ("DBM is over [redacted]% budget constrained.").

198. Managing campaign budgets is an essential function of a buy-side tool. If a buy-side tool submits bids for *every* impression based on an advertiser's maximum willingness-to-pay *without* taking its budget into account, that advertiser would often find itself exhausting its budget quickly.[391] There are several reasons why this may be an undesirable outcome for the advertiser. *First*, many advertisers prefer to deliver ads smoothly over a campaign period, rather than very rapidly at the start of the campaign, to expand the set of users reached by the campaign.[392] *Second*, by choosing bids based on the maximum willingness-to-pay for *every* arriving impression, an advertiser might miss out on the opportunity to win later-arriving impressions at lower prices than earlier-arriving ones. *Third*, the budget management strategies of competing bidders can interact to distort pricing patterns. For example, early in the development of search advertising, Google found that cost-per-click spiked at the beginning of the day and decreased over the course of the day as bidders' daily budgets ran out, leading to an end-of-day price [redacted]% lower than at the start of the day.[393] That pricing pattern suggests a failure to manage bidder budgets well: in the absence of budget throttling, bidders would spend most of their budgets on impressions at the start of the day when competition for each impression was high, even though they could have spent the same budget to win more impressions later

[391] "Introduction to Budget Throttling" (Mar. 1, 2018), GOOG-DOJ-03792729, at -730 ("In practice there are plenty of such campaigns where the potential spend is 100x (or even more) higher than the advertiser's specified budget. In fact, lots of YouTube campaigns can exhaust their daily budget in less than [redacted].").

[392] Xu, J., Lee, K. C., Li, W., Qi, H., & Lu, Q. (2015). Smart pacing for effective online ad campaign optimization. In *Proceedings of the 21th ACM SIGKDD International Conference on Knowledge Discovery and Data Mining* (pp. 2217-2226) ("In targeted online advertising, advertisers look for maximizing campaign performance under delivery constraint within budget schedule. Most of the advertisers typically prefer to impose the delivery constraint to spend budget smoothly over the time in order to reach a wider range of audiences and have a sustainable impact.").

[393] "Introduction to Budget Throttling" (Mar. 1, 2018), GOOG-DOJ-03792729, at -731 ("This is exactly how the system worked before probabilistic throttling was introduced in 2006, and was captured in the original probabilistic throttling design doc [...] . Basically, CPC spiked at day start, and kept decreasing, to about [redacted]% lower at day end. In fact, the problem was mitigated by budget curve (which we will discuss later in this doc) or it would have been a lot worse. Today, there is no CPC jump at day boundary").

in the day. That would lead to an inefficient outcome whenever advertisers with very high values for later-arriving impressions would fail to win them because they had already exhausted their budgets.

199. **Budget throttling** (also known as budget pacing) is a commonly-used heuristic approach by which bidders manage the rates at which their ads are shown and budgets are spent in online auctions.[394] Under budget throttling, Google would calculate bids for an advertiser for only a fraction of the impressions for which the advertiser was eligible.[395] For example, suppose that an advertiser had a budget of $100 per day to spend on a display advertising campaign, and that Google Ads—if it bid for the advertiser on *each* eligible impression without taking its budget into account—would spend $2,400 per day on eligible impressions for the advertiser. Without budget throttling (and assuming that average impression prices and numbers did not fluctuate over the course of the day), Google Ads might find that the advertiser's budget was exhausted in the first hour of the day. With budget throttling, Google Ads would instead bid on roughly one in every twenty-four impressions, leading to its budget being more smoothly spent over the course of the day.

200. Originally, Google implemented budget throttling by randomizing auction participation separately for each bid request it received.[396] In that implementation of budget throttling,

[394] Gui, G., Nair, H., & Niu, F. (2021). Auction throttling and causal inference of online advertising effects. arXiv preprint arXiv:2112.1515; Balseiro, S., Kim, A., Mahdian, M., & Mirrokni, V. (2017). Budget management strategies in repeated auctions. In *Proceedings of the 26th International Conference on World Wide Web* (pp. 15-23) .

[395] "Introduction to Budget Throttling" (Mar. 1, 2018), GOOG-DOJ-03792729, at -733 ("Probabilistic throttling is the basic layer of throttling. It was first introduced in 2006. The idea is simple: it computes an impression probability (IP) for each campaign, and throttles ad candidates randomly according to IP.").

[396] Design Document, "Cookie Budget Throttling" (Apr. 19, 2017), GOOG-DOJ-AT-02472888, at -888 ("However, budget throttling works by choosing a random number on each query.").

Google would adjust the probability of an advertiser bidding on each impression adaptively to target the advertiser's desired daily spend, increasing it if the advertiser had spent less budget than expected over the course of the day, and lowering it if the advertiser had spent more budget than expected.[397]

C. How Some Publishers and Exchanges Gamed Budget Throttling

201. By 2017, Google observed that some publishers and exchanges "exploited" Google's implementation of budget throttling to increase Google's spend on their impressions at the expense of other publishers and exchanges.[398] Because Google determined each advertiser's participation using an *independent* coin flip for each bid request, an exchange or a publisher could increase its probability of receiving a bid from a higher-value bidder on Google Ads or DV360 by sending multiple bid requests for the same impression.[399] For example, suppose DV360 had five advertisers eligible for an impression, two of whom with value \$10 and three of whom with value \$1 for the impression. A publisher receiving a bid of \$1 from DV360 for the impression might be tempted to send one or more additional bid requests to DV360 for the same impression, hoping that DV360 would bid \$10 on one of those requests. In addition to multi-calling AdX (in the way I

[397] *See* "Introduction to Budget Throttling" (Mar. 1, 2018), GOOG-DOJ-03792729, at -733 ("How is [Impression Probability] calculated? We use a [Proportional-Integral-Derivative] controller that computes [Impression Probability] by tracking a target spend curve.").

[398] Performance Review Document [redacted], "Tim perf Q3 2019 (original structure)" (Sep. 9, 2019), GOOG-DOJ-AT-02218994, at -998 ("When buying on multiple exchanges, our budget controller roughly apportioned budget based on query volume. Some exchanges exploited this by sending the same query multiple times, inflating their share of budget-constrained spend (which is most of DBM).").

[399] Presentation, "Bidding in Adversarial Auctions" (Nov. 27, 2017), GOOG-DOJ-05282625, at -647 ("Exchanges send multiple calls for a single query to get multiple shots at budget throttling and land the largest bid [...] Money flows to publishers and exchanges that use repeated calls"); Design Document, "Cookie Budget Throttling" (Apr. 19, 2017), GOOG-DOJ-AT-02472888, at -888 ("However, budget throttling works by [redacted] This means that it can make different decisions for queries that actually represent the same inventory.").

discussed in Section IV), a publisher might also receive different bids from DV360 if it offered the impression via multiple exchanges. Non-Google exchanges could similarly fish for a higher bid by sending multiple bid requests for the same impression, a tactic known as **bid duplication**.[400] For example, if a non-Google exchange observed that DV360 had a high-value bidder for a certain piece of inventory around half the time it was called to bid, it might call DV360 to bid two or more times for the impression until it observed a high bid. Bid duplication has the effect of transforming the fair coin flip used to determine the advertiser represented by DV360 (and thus the bid received by the exchange) into a *series* of coin flips, repeated until the desired outcome is observed. In the words of one Google engineer, such a strategy "tricks [Google's] budget system into allocating more [...] budget to that exchange than its fair share."[401]

202. If left unaddressed, multi-calling and bid duplication can have several deleterious effects on the ad tech ecosystem.

203. *First*, these strategies undermine the budget-management techniques of buy-side tools, harming their advertiser customers. By calling a buy-side tool to bid multiple times until a desired outcome is achieved, a publisher or exchange can undo the intended effects of budget throttling, leading to bidder budgets being depleted more rapidly than bidders intend.

[400] Presentation, "Bidding in Adversarial Auctions" (Nov. 27, 2017), GOOG-DOJ-05282625, at -647 ("Exchanges send multiple calls for a single query to get multiple shots at budget throttling and land the largest bid[.]"); Sarah Sluis, "Attack Of The Clones: Programmatic's Hidden Scourge Of Bid Duplication," AdExchanger (Jan. 17, 2024), https://www.adexchanger.com/platforms/attack-of-the-clones-programmatics-hidden-scourge-of-bid-duplication/ ("Programmatic auctions are creating so many carbon copies of themselves, it's threatening to topple the entire structure of programmatic. The bid duplication is getting so extreme, buyers are starting to take notice of this strange behavior. Instead of seeing the whole universe of bid opportunities, demand-side platforms see only a small portion of inventory copied many times, which impairs their ability to scale campaigns.").

[401] Design Document, "Cookie Budget Throttling" (Apr. 19, 2017), GOOG-DOJ-AT-02472888, at -888.

204. *Second*, multi-calls and bid duplication raise costs for advertisers and their ad tech suppliers. The increased volume of bid requests creates engineering challenges for bidders, including attempts to "deduplicate" bid requests: a costly and imperfect process that seeks to identify when different bid requests correspond to the same impression.[402] Because the process of bid deduplication is imperfect, advertisers may miss out on valuable transaction opportunities or overpay for some impressions. Moreover, each additional call to bid creates additional time for bid requests to be processed and responded to, increasing ad latency.[403]

205. *Third*, multi-calling and bid duplication can harm publishers too. Because budgets are reallocated towards the publisher or exchange pursuing a successful multi-calling or bid duplication strategy, these strategies create a negative externality in the form of reduced payments to other publishers and exchanges.[404] This creates an incentive for the

[402] Sarah Sluis, "Attack Of The Clones: Programmatic's Hidden Scourge Of Bid Duplication," AdExchanger (Jan. 17, 2024), https://www.adexchanger.com/platforms/attack-of-the-clones-programmatics-hidden-scourge-of-bid-duplication/ ("To combat bid duplication, DSPs have turned to traffic shaping, a technique that filters excess bids using a combination of algorithms and manual selection to curate the inventory that buyers evaluate. [...] Processing billions of bid requests is expensive. In the face of skyrocketing cloud bills, SSPs and DSPs alike have implemented traffic-shaping tech as a cost-savings measure."); Sarah Sluis, "The Trade Desk Suppresses Bid Duplication Amid COVID-19 Traffic Surge," AdExchanger (Apr. 21, 2020), https://www.adexchanger.com/platforms/the-trade-desk-suppresses-bid-duplication-amid-covid-19-traffic-surge ("The idea of cutting down on bid duplication predates the coronavirus pandemic. But the extra traffic has added millions in server costs, a burden shouldered largely by DSPs, as well as the agencies and marketers who pay for this cost as part of the ad tech tax.").

[403] Oded Poncz, "Traffic Duplication Might Be A Bigger Problem Than Ad Fraud," AdExchanger Opinion (Jan. 11, 2016), https://www.adexchanger.com/data-driven-thinking/traffic-duplication-might-even-be-a-bigger-problem-than-ad-fraud/ ("Another side effect of bid request duplication is that re-auctioning a bid takes time. In some cases, this could even become apparent to the end user. For example, if an end user is waiting for an interstitial ad to be shown upon opening an application, while behind the scenes there are a few auctions taking place for the same ad space, this will result in the user waiting considerably longer until they're able to access their content. This doubling of ad requests also adds to the overall latency in the ad ecosystem. If all this duplication means an ad takes five seconds to load, that makes for a poor consumer experience.").

[404] Design Document, "Cookie Budget Throttling" (Apr. 19, 2017), GOOG-DOJ-AT-02472888, at -888 ("In particular, a single third-party exchange can send multiple queries for the same inventory, which effectively tricks our budget system into allocating more than budget to that exchange than its fair share. This trick works because the random throttling allocates budget according to the share of queries, but this allocation doesn't represent the actual

publishers and exchanges harmed by those practices to themselves adopt multi-calling and bid duplication, compounding the negative effects for advertisers and other publishers described above.[405] The responses of bidders to bid duplication, which may include reduced or less frequent bids on all impressions, can also reduce publisher revenues.[406]

D. How Elmo Protected Advertisers and Disincentivized Multi-Calling and Bid Duplication

206. DV360 launched Project Elmo in November 2017[407] and Google Ads launched it in November 2018[408] to ensure that Google's bid management algorithms worked as intended despite the onslaught of multi-calling and bid duplication tactics by exchanges and publishers.[409] Rather than randomizing participation of budget-constrained

inventory available in the case of multiple requests for the same inventory."); Presentation, "Bidding in Adversarial Auctions" (Nov. 27, 2017), GOOG-DOJ-05282625, at -647 ("Money flows to publishers and exchanges that use repeated calls").

[405] *See* Sarah Sluis, "Attack Of The Clones: Programmatic's Hidden Scourge Of Bid Duplication," AdExchanger (Jan. 17, 2024), https://www.adexchanger.com/platforms/attack-of-the-clones-programmatics-hidden-scourge-of-bid-duplication/ ("The issues caused by bid duplication are no secret. But, as is often the case in ad tech, being proactive is a disadvantage. Any single publisher attempting to fix the issue on their own will experience a decrease in revenue so profound that changing alone isn't an option. Meanwhile, removing waste from bid duplication could squeeze SSPs, who each get a chance to sell everything under the current setup.").

[406] Sarah Sluis, "Attack Of The Clones: Programmatic's Hidden Scourge Of Bid Duplication," AdExchanger (Jan. 17, 2024), https://www.adexchanger.com/platforms/attack-of-the-clones-programmatics-hidden-scourge-of-bid-duplication/ ("To combat bid duplication, DSPs have turned to traffic shaping, a technique that filters excess bids using a combination of algorithms and manual selection to curate the inventory that buyers evaluate. But the process doesn't actually deduplicate impressions for DSPs, and, paradoxically, the guesses made during traffic shaping can exacerbate the negative effects of duplication. [...] Traffic-shaping algorithms rely on historical data about what inventory has been bid on in the past to determine what to send buyers in the future. The danger in this approach is that buyers end up seeing an increasingly narrow view of what's out there, losing the chance to discover new inventory.").

[407] Launch Details Spreadsheet, Launch 209956 (Aug. 29, 2023), GOOG-AT-MDL-009644201, at cells C1, C4 ("Launch Date [:...] 2017-11-29").

[408] Email from [redacted] to [redacted], "[Launch 205617] Cookie-based budget throttling for GDN advertisers" (Dec. 6, 2018), GOOG-AT-MDL-015521456, at -456 ("Launch Date [...] 2018-11-19").

[409] Design Document, "Cookie Budget Throttling" (Apr. 19, 2017), GOOG-DOJ-AT-02472888, at -888 ("Various kinds of publisher mediation (e.g. header bidding, multiple calls) can cause us to see multiple queries for the same

advertisers independently for each bid request it received, Elmo ensures that the *same* budget-constrained advertisers participate in all bid requests associated with a given cookie (see Section III.B.2) within a time period of [redacted].[410, 411] This creates consistency in the bids sent by Google Ads and DV360 across bid requests for a given cookie within the [redacted] time window. The [redacted] time window was "long enough so that multiple mediated queries are likely to fall within the same window, but short enough so that budget-constrained ad[vertisers] still have a chance to show [an ad] to any given user."[412]

207. Elmo reduces incentives for bid duplication and multi-calling designed to solicit a high bid from Google's buy-side tools. Because Elmo ensures that Google's buy-side tools choose the same sets of participants for bid requests for the same cookie that are received in close succession, an exchange contemplating a bid-duplication strategy or a publisher contemplating a multi-calling strategy can expect to receive the same bids from Google's buy-side tools on each bid request it sends, eliminating much of the benefit of such a strategy.

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inventory. However, budget throttling works by choosing a random number on each query. This means that it can make different decisions for queries that actually represent the same inventory. In particular, a single third-party exchange can send multiple queries for the same inventory, which effectively tricks our budget system into allocating more than budget to that exchange than its fair share. This trick works because the random throttling allocates budget according to the share of queries, but this allocation doesn't represent the actual inventory available in the case of multiple requests for the same inventory. We want to change the budget throttling algorithm so that it makes a consistent decision across those queries, while still achieving the goal of hitting the impression probability overall.").

[410] Similarly, the same set of advertisers are throttled (or *not* participating) in each bid request associated with the cookie in that [redacted].

[411] Design Document, "Cookie Budget Throttling" (Apr. 19, 2017), GOOG-DOJ-AT-02472888, at -889 ("Within each [redacted] window, every query for the same delivery period on the same cookie gets the same throttling decision."); Presentation, "Bidding in Adversarial Auctions" (Nov. 27, 2017), GOOG-DOJ-05282625, at -648 ("We fix the advertisers that can purchase a query from a given cookie during any specific time_bucket (budget throttling based on cookie x time bucket)").

[412] Design Document, "Cookie Budget Throttling" (Apr. 19, 2017), GOOG-DOJ-AT-02472888, at -889.

208. Meanwhile, Elmo does *not* reduce the average revenues of publishers using header bidding, Open Bidding or alternative mediation techniques to offer a single impression to multiple exchanges. Because Elmo ensures that the same advertisers using Google's buy-side tools are participating in each auction for which they are called to bid, it levels the playing field between exchanges: the winner is not merely the exchange chosen randomly to receive a high bid from Google's buy-side tools, as could happen under the previous budget throttling design. To the extent that Elmo successfully disincentivizes multi-calling and bid duplication, publishers also benefit from the elimination of the harmful externalities that they suffer when other publishers and exchanges adopt those practices.

209. A Google analysis found that Elmo decreased spending on exchanges employing bid duplication and increased it for "cleaner" exchanges not using those tactics (including AdX, United, and Improve Digital).[413] Non-Google display advertising tools (including The Trade Desk and Magnite) have also sought to combat bid duplication,[414] [redacted]

[413] Presentation, "Bidding in Adversarial Auctions" (Nov. 27, 2017), GOOG-DOJ-05282625, at -650 ("We see a significant drop in exchanges that exploited this mechanism and gains for the cleaner exchanges [redacted].

[414] Sarah Sluis, "Attack Of The Clones: Programmatic's Hidden Scourge Of Bid Duplication," AdExchanger (Jan. 17, 2024), https://www.adexchanger.com/platforms/attack-of-the-clones-programmatics-hidden-scourge-of-bid-duplication/ ("Processing billions of bid requests is expensive. In the face of skyrocketing cloud bills, SSPs and DSPs alike have implemented traffic-shaping tech as a cost-savings measure. Magnite, for instance, bought nToggle for traffic shaping back in 2017."); Sarah Sluis, "The Trade Desk Suppresses Bid Duplication Amid COVID-19 Traffic Surge," AdExchanger (Apr. 21, 2020), https://www.adexchanger.com/platforms/the-trade-desk-suppresses-bid-duplication-amid-covid-19-traffic-surge ("So two weeks ago, The Trade Desk asked exchanges to stop sending duplicate bid requests for the same ad impression.").

[redacted][415]

E. Responding to Plaintiffs' Allegations

210. Plaintiffs allege that "Google devised project Elmo to help DV360 identify when it saw the same bid request across multiple exchanges, and it decreased overall ad spend on any exchange that it suspected to meaningfully engage in header bidding,"[416] and that it "represent[ed] a campaign to undermine the success of header bidding and starve rival exchanges of their primary source of demand."[417] None of these claims are correct.

211. *First*, Elmo was designed to ensure consistent bids both when *multiple* exchanges issue bid requests for the same impression and when *a single* publisher or exchange calls Google's buy-side tools multiple times for the same impression. In this way, Elmo disincentivizes the harmful tactics of multi-calling by publishers and bid duplication by exchanges. Because of Elmo, for each impression, all exchanges are treated equally: winning the impression does not depend on being the "lucky" exchange chosen randomly by the budget-throttling algorithm to receive the high bid from Google's buy-side tools.

[415] [redacted]

[416] Fourth Amended Complaint ¶ 403.

[417] Fourth Amended Complaint ¶ 405.

212. *Second*, Elmo did not penalize header bidding exchanges: it removed the advantages of bid duplication, regardless of whether the exchange participated in header bidding. Elmo did not "starve" non-Google exchanges of demand from Google's buy-side tools. Several non-Google exchanges—particularly those Google identified as not engaged in bid duplication—saw *increased* spending from Google as a consequence of Elmo.[418]

213. *Finally,* Elmo represented Google's buy-side tools *adapting* to header bidding, rather than undermining it. By protecting Google's advertiser customers from harmful tactics like bid duplication and multi-calling, Elmo ensured that its advertiser customers could safely participate in auctions for impressions on multiple exchanges, encouraging more participation. Advertisers no longer needed to fear that unscrupulous publishers and exchanges would undermine their budget-management strategies.

214. None of the Plaintiffs' experts conduct substantive analysis of Project Elmo. Professor Gans claims that "Google increased barriers to entry through Projects Poirot and Elmo," but he provides no support for that conclusion as it pertains to Project Elmo.[419] In fact, as I discussed above, Project Elmo did not increase barriers to entry; it instead treated all exchanges equally. Dr. Chandler includes Elmo in a list of programs that he claims "jeopardized, and detrimentally affected, transparency and fairness of the auctions in which they were employed."[420] He provides no analysis to support that conclusion as it pertains to Project Elmo, and his conclusion is incorrect: Project Elmo made auctions

[418] Presentation, "Bidding in Adversarial Auctions" (Nov. 27, 2017), GOOG-DOJ-05282625, at -650 ("We see a significant drop in exchanges that exploited this mechanism and gains for the cleaner exchanges. [redacted]).

[419] Expert Report of J. Gans (Jun. 7, 2024), at ¶ 864.

[420] Expert Report of J. Chandler (Jun. 7, 2024), at ¶ 23.

fairer by treating all exchanges equally, and it made participation in auctions safer for advertisers using Google's buy-side tools.

VII. POIROT AND MARPLE: IMPROVING RETURNS FOR ADVERTISERS BY OPTIMIZING BIDS IN NON-SECOND PRICE AUCTIONS

A. Overview

215. Poirot and Marple were bid optimization programs on DV360 and Google Ads, respectively, that were designed to (i) identify exchanges using non-second price auctions and (ii) bid to maximize expected advertiser surplus on those exchanges.[421] These programs benefited advertisers by increasing their returns from online display advertising, regardless of advertisers' campaign objectives. The programs made bidding easier for advertisers by automating the experiments and computations that advertisers would otherwise seek to make themselves. In doing so, they improved bidding accuracy, improving matching and reducing costs for advertisers.

216. Adopting the Plaintiffs' emphasis, I focus most of my discussion in this chapter on Poirot. Each allegation made by Plaintiffs about Poirot is either incorrect or founded on faulty assumptions:

a. Plaintiffs and their experts argue that Poirot conferred "no actual benefit to advertisers,"[422] but this is incorrect. The program both improved bidding and

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[421] *See* Design Doc, "Poirot Design Doc" (Apr. 25, 2017), GOOG-DOJ-13627809, at -809 ("The goal of Poirot is to discover the exchanges that deviate from second pricing and bid appropriately on these to improve advertiser performance on these exchanges."), -811 ("Our optimization problem can be stated as follows: For each advertiser, find bidding policy *f(query features, ad features)* that maximizes $\Sigma_i v - c_i$."); Declaration of N. Jayaram (Aug. 5, 2023), GOOG-AT-MDL-008842383, at ¶ 26 ("In July 2017, Google launched Project Poirot, an algorithm designed to protect DV360 advertisers from overbidding on exchanges that deviated from second-price auctions"). *See also* Presentation, "Poirot Launch Metrics" (Oct. 5, 2021), GOOG-DOJ-AT-02480338, at -341; Email from [redacted] to [redacted] "[Launch 187971] Project Poirot (**DRAFT**)" (Apr. 11, 2017), GOOG-DOJ-14398809, at -810 ("This launch changes bids for fixed CPM DBM advertisers to maximize advertiser surplus."); Presentation, "DV360 optimizations ENG deep dive" (Jan. 24, 2020), GOOG-DOJ-11733552, at -577.

[422] Fourth Amended Complaint ¶ 400 ("[Poirot was] a direct reallocation of advertising dollars to Google's own ad exchange with no actual benefit to advertisers."). *See also* Expert Report of J. Gans (Jun. 7, 2024), at ¶ 865 ("Poirot

increased advertiser surplus, as verified by Google's internal experiments.[423] Poirot also protected DV360 advertisers from misleading tactics from exchanges that ran so-called "dirty auctions," in which the exchange claimed to use one auction format to sell an impression, but actually used another.[424]

b. Plaintiffs and their experts allege that Poirot was designed to shift advertiser spending from header bidding to AdX, but this, too, is incorrect.[425] Poirot applied to non-second-price auctions, regardless of whether the exchange participated in header bidding. It did not shade bids into exchanges using second-price auction rules,[426] nor did it shade bids below the value that maximized advertiser surplus.[427]

resulted in reallocating revenue from rival exchanges to Google's own exchange, which had no benefit to advertisers or publishers.").

[423] *See* Email from [redacted] to [redacted] et al., "Re: Poirot to launch 6/19" (Aug. 20, 2017), GOOG-DOJ-07825115, at -115 ("Through experiments, we measured that […] the surplus increases by 12% in the affected exchanges as a result of this launch."); Design Doc, "Poirot Design Doc" (Apr. 25, 2017), GOOG-DOJ-13627809, at -815 ("The following table shows the impact limited to the non-second price auction exchanges."; "surplus [...] change[:] 15.57%"). Google experiments found that Poirot increased advertiser surplus by 6% on all exchanges, including second-price exchanges. *See* Presentation, "Bidding in Adversarial Auctions" (Nov. 27, 2017), GOOG-DOJ-05282625, at -644 ("Advertiser impact […] 6% surplus increase").

[424] Presentation, "Bidding in adversarial auctions" (Nov. 27, 2017), GOOG-DOJ-05282625, at -635 to -636 ("There are roughly three types of auctions[:] Second price (buyer bids truthfully)[,] First price (buyer has to shave bids)[,] Dirty (called second price, but really more like first price) […] Project Poirot ensures advertiser bids are protected").

[425] Fourth Amended Complaint, Section VII.D.3.v ("Google diverts ad spend away from rival exchanges that engage in header bidding."); Expert Report of J. Gans (Jun. 7, 2024), at ¶¶ 863-64 ("In addition to the conduct that I have found to be anticompetitive in itself, there were additional actions aimed at limiting the impact of Header Bidding [...] As one example, Google increased barriers to entry through Projects Poirot and Elmo.").

[426] Such exchanges include United and Improve Digital. *See* Declaration of N. Jayaram (Aug. 5, 2023), GOOG-AT-MDL-008842383, at ¶ 33 ("Poirot also found that reducing bids into some other ad exchanges (such as Improve Digital and United) did not increase advertiser surplus by more than the [redacted] percent threshold, so Poirot did not lower DV360 bids into those exchanges either.").

[427] Declaration of N. Jayaram (Aug. 5, 2023), GOOG-AT-MDL-008842383, at ¶ 31 ("Poirot's process for calculating multipliers that maximized expected advertiser surplus did not take into account whether an ad exchange participated in header bidding."); Design Doc, "Poirot Design Doc" (Apr. 25, 2017), GOOG-DOJ-13627809, at -811 ("Our optimization problem can be stated as follows: [redacted]

c. Plaintiffs also allege that Poirot redirected ad spend to AdX when it "engaged in exactly the same behavior" that DV360 criticized, but from September 2017 (just two months after its launch in July 2017) up until the transition to the UFPA in September 2019, Poirot applied in just the same ways to AdX as to other exchanges.[428, 429] After the transition to the UFPA, DV360 optimized bids to the new AdX format with an updated Poirot algorithm that used the minimum-bid-to-win information provided by AdX to all bidders.[430]

d. Plaintiffs characterize Poirot as a "strateg[y] to reduce advertiser spend on rival exchanges,"[431] but this analysis relies on two false assumptions: that advertisers would not otherwise shade bids on their own and that advertiser savings from Poirot would go unspent.

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[428] Fourth Amended Complaint ¶ 400 ("[With Poirot,] DV360 was actually redirecting that ad spend to a marketplace that engaged in exactly the same behavior.").

[429] *See* Declaration of N. Jayaram (Aug. 5, 2023), GOOG-AT-MDL-008842383, at ¶¶ 33, 35-36 ("Since September 2017, Poirot has applied on AdX and on all third-party ad exchanges on which DV360 bids."); Deposition of [redacted] at 274:9-13 (Sep. 17, 2021), GOOG-AT-MDL-007173084, at -358 ("A. Google's buy side algorithms run across all the traffic. So that—whether it's AdX or third-party exchanges, the algorithm that we are talking about [Poirot] applies on all the traffic for DV360.").

[430] The minimum-bid-to-win information is provided to bidders at the conclusion of an auction for an impression on AdX and tells the bidder the minimum bid it would have needed to make to win an auction. *See* Google, "Bid data sharing," Authorized Buyers Help (accessed Jul.Dec. 24, 2024), https://support.google.com/authorizedbuyers/answer/2696468?hl=en ("[W]hen a bidder submits a valid bid into the auction, they receive back the minimum value they would have had to bid to win that auction, whether they lost or won."). *See also* Declaration of N. Jayaram (Aug. 5, 2023), GOOG-AT-MDL-008842383, at ¶ 35 ("Poirot was also updated following Google's shift to a Unified First Price Auction. With the transition to a Unified First Price Auction, Google began providing minimum-bid-to-win data to buyers, and DV360 began to use that minimum-bid-to-win data to inform how Poirot would lower bids into AdX in order to optimize for expected advertiser surplus.").

[431] Fourth Amended Complaint ¶ 405 ("Taken together, Poirot, Elmo, and other strategies to reduce spend on rival exchanges represent a campaign to undermine the success of header bidding and starve rival exchanges of their primary source of demand."). *See also* Expert Report of J. Gans (Jun. 7, 2024), at ¶ 865 ("Poirot resulted in reallocating revenue from rival exchanges to Google's own exchange, which had no benefit to advertisers or publishers. They are examples of the actions that Google could take to alter the flow of information into markets in ways that were not motivated by the needs of Google consumers (publishers/advertisers) but could disrupt the efficient operation of markets in ways that potentially reduced match quality and, potentially, and made it more difficult for rival exchanges and entrants to compete.").

B. Background: Non-Second-Price Auctions

217. As I discussed in Section III.C.4, many ad exchanges switched from using second-price auctions to non-second-price auctions for online display advertising impressions between 2017 and 2019.[432] During this transitional period, different exchanges used different auction formats, and some exchanges even used different auction formats for different impressions.[433] Some exchanges ran what Google engineers called **dirty auctions**, meaning that they claimed to run a second-price auction but actually tried to extract additional payments from bidders by charging the winner a price between its own bid and the highest losing bid.[434] In this section, I refer to both first-price auctions and dirty auctions as **non-second-price auctions**.

218. To illustrate a dirty auction, suppose an exchange sets a floor price of $4.00, and then observes that the only bid above the floor price is $5.00. In a second-price auction, the bidder would pay $4.00. In a dirty auction, the exchange might charge a higher price, such as $4.60, claiming that was the second-highest bid. From the price and its bid alone, a bidder would be unable to detect that the exchange had charged a price different from the second-highest bid.

[432] *See* Presentation, "DV360, Third Party Exchanges, and Outcome-Based Buying" (Oct. 16, 2018), GOOG-DOJ-12038253, at -267 (Figure: "Impression Share (US Ad Inventory)," "First-price auction": [redacted] in December 2017, [redacted]% in March 2018, "Second-price auction with anomalies": [redacted]% in December 2017, [redacted]% in March 2018).

[433] *See* Presentation, "Poirot with auction type signal" (Nov. 5, 2018), GOOG-DOJ-05283173, at -185 (Figure: "Impression volume per auction type").

[434] Presentation, "Bidding in adversarial auctions" (Nov. 27, 2017), GOOG-DOJ-05282625, at -635 ("There are roughly three types of auctions[:] Second price (buyer bids truthfully)[,] First price (buyer has to shave bids)[,] Dirty (called second price, but really more like first price)").

219. As I have emphasized (see Section III.C above), a surplus-maximizing bidder must bid differently depending on the auction's pricing rule.[435] This created new challenges for bidders in the transitional period in which exchanges differed in their pricing rules: how to predict the auction format used for a given impression, and how to optimize bids to that format. As I have discussed above, second-price auctions are bidder-truthful, meaning that bidders maximize their surplus by bidding their values, whereas first-price auctions are not, so that bidders in these auctions maximize surplus by shading their bids. Dirty auctions also fail to be bidder-truthful and may be even more challenging for bidders, since a bidder may need to monitor its auction performance over time to detect changes in the auction format and adapt bids accordingly. The benefits of bid-shading were widely understood in the online display advertising industry.[436]

C. All Advertisers Should Maximize Expected Surplus

220. Online display advertising campaigns can have many different objectives, which may involve acquiring a fixed number of impressions in some time period or maximizing clicks subject to a fixed budget or allocating a budget between advertising on the web or other media, and others. Regardless of the advertiser's campaign objective, it can always

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[435] *See, e.g.*, Milgrom, P. R. (2004). *Putting auction theory to work*. Cambridge University Press, at 110-16.

[436] *See, e.g.*, Jessica Davies, "What to know about Google's implementation of first-price ad auctions," Digiday (Sep. 6, 2019), https://digiday.com/media/buyers-welcome-auction-standardization-as-google-finally-goes-all-in-on-first-price/ ("[D]emand-side platforms came up with bid shading as a way to help buyers transition to first-price auctions where they have to be willing to pay what they bid"); Digiday, "In programmatic, buyers sometimes don't know what type of auction they're bidding in," Digiday (Jun. 30, 2017), https://digiday.com/marketing/ad-buyers-programmatic-auction/ ("A buyer might think they're buying based on second price but really be in a first-price auction. That can get expensive, since the bid strategies are far different"); Sarah Sluis, "Big Changes Coming To Auctions, As Exchanges Roll The Dice On First-Price," AdExchanger (Sep. 5, 2017), https://www.adexchanger.com/platforms/big-changes-coming-auctions-exchanges-roll-dice-first-price/ ("[I]f programmatic traders think they are still playing according to second-price auction rules, they will overpay for inventory. To combat price increases, some buyers have already started shading, or reducing bid prices.").

acquire the same number of impressions at *minimum* cost by adopting a bidding strategy that *maximizes* the expected surplus from each auction opportunity, using a properly determined value for each individual impression.[437] A surplus maximization strategy (which is the type of strategy implemented by Poirot) can thus serve the interests of every advertiser, regardless of its campaign objectives, by achieving those objectives at minimum cost.

D. Poirot Benefited Advertisers By Optimizing Bids to Auction Formats

1. Overview of Project Poirot

221. Poirot was a DV360 program to make it easier for advertisers on DV360 who set up their campaigns using **fixed CPM** bidding (also known as **manual bidding**) to implement optimal bidding strategies.[438] Fixed CPM bidding is an option in DV360 that allows advertisers to specify an amount that DV360 "can spend to win any individual impression

[437] This claim relies on the two assumptions that (1) the bidder can win any fraction of similar auctions for an impression by varying its bid from low to high and (2) the bidder (or its DSP) accurately estimates the distributions of bids in the auctions. Let us begin with some arbitrary bidding strategy *B* for the advertiser. Assumption (1) implies that there is some value that it can use with expected-value-maximization bidding that wins the same expected number of impressions as bidding strategy *B*. Assumption (2) implies that the *expected* number of impressions and *expected* surplus are equal to the *realized* numbers. Since both strategy *B* and the new strategy win impressions of the same total value and the expected-surplus-maximizing strategy has a higher surplus, it must have a lower cost.

[438] *See* Design Doc, "Poirot Design Doc" (Apr. 25, 2017), GOOG-DOJ-13627809, at -811 ("Note that this project is only applied to Fixed CPM bidders."). *See also* Presentation, "Poirot Review" (Jun. 10, 2019), GOOG-DOJ-32261273, at -285 ("To date, fixed bidding in DBM has always bid the the [*sic*] exact inputted CPM/1000 for every impression. Now, in order to ensure advertisers are getting the best possible price for each impression, we are preparing to launch an optimization with the goal of winning the same impression for a lower price. For Optimized Fixed CPM Bidding [Poirot], the inputted CPM value will serve as a maximum CPM bid, as opposed to a fixed CPM bid - we will never bid more than the inputted value.").

for a line item."[439] In 2017, most DV360 advertisers used manual bidding, although automated bidding strategies have since become more popular.[440]

222. Before Poirot, fixed CPM bidding used the same bid for each impression, regardless of the auction format being used for a given impression.[441, 442] A built-in functionality to adapt bids to the auction format was not demanded when the vast majority of exchanges used second-price auctions, but its absence became a problem when exchanges started to use different pricing rules because advertisers needed to adapt their bids to the auction format in order to maximize their profits. Project Poirot launched fully in July 2017[443] and replaced fixed CPM bidding with **optimized fixed CPM bidding**, in which DV360 treated the CPM reported by a DV360 advertiser as its value (its optimal bid into a clean second-price auction) and optimized the advertiser's bid to the auction format of the exchange offering the impression.[444]

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[439] Google, "Set a fixed CPM bid for a line item," Display & Video 360 Help (accessed Jul.. 24, 2024), https://support.google.com/displayvideo/answer/2696858?hl=en.

[440] *See* Presentation, "DV360, Third Party Exchanges, and Outcome-Based Buying" (Oct. 16, 2018), GOOG-DOJ-12038253, at -265 ("Auto-bidding Adoption[:] Jan 2017: 17% [,] Sep 2018: 40%").

[441] *See* Presentation, "DV360 optimizations ENG deep dive" (Jan. 24, 2020), GOOG-DOJ-11733552, at -553 ("DV360 three years ago: Mostly fixed CPM manual bidding").

[442] Advertisers could set up separate line items for different exchanges (assuming they knew the auction formats), but at the time of Poirot's launch, "barely any" advertisers set exchange-specific fixed CPMs. *See* Presentation, "Poirot Review" (Jun. 10, 2019), GOOG-DOJ-32261273, at -286. Even so, exchange-specific line items would be insufficient to allow advertisers to optimize bids to the "auction type" signals as in Poirot v2 (see Paragraph 235 below).

[443] *See* Email from [redacted] to [redacted] and [redacted], "Metrics post Poirot launch" (Jul. 24, 2017), GOOG-DOJ-05270417, at -417 ("Poirot was launched fully on July 19, 2017.").

[444] *See* Presentation, "Poirot Review" (Jun. 10, 2019), GOOG-DOJ-32261273, at -285 for an explanation of fixed CPM bidding and optimized fixed CPM bidding (Poirot) ("To date, fixed bidding in DBM has always bid the the [*sic*] exact inputted CPM/1000 for every impression. Now, in order to ensure advertisers are getting the best possible price for each impression, we are preparing to launch an optimization with the goal of winning the same impression for a lower price. For Optimized Fixed CPM Bidding [Poirot], the inputted CPM value will serve as a maximum CPM bid, as opposed to a fixed CPM bid - we will never bid more than the inputted value.").

223. Aptly named after a famous fictional sleuth, Poirot was designed to "discover the exchanges that deviate from second pricing and bid appropriately on these to improve advertiser performance on these exchanges."[445] To discover the exchanges deviating from second-price rules, Poirot conducted experiments to determine whether bidding an advertiser's value on an exchange was an optimal or near-optimal strategy. I describe these experiments in detail below. Poirot then adjusted advertisers' bids into the exchanges that it found were deviating significantly from second-pricing in order to maximize the expected advertiser surplus.[446] Poirot applied the same experiment-and-optimize algorithm to all non-Google exchanges from its launch in July 2017, and it applied the same algorithm to AdX from September 2017 onwards.[447]

224. Although DV360 expected that most fixed CPM advertisers would benefit from Poirot, it notified advertisers that they could "opt out" of optimized fixed CPM bidding by unchecking a box in the DV360 user interface.[448] Fewer than [redacted]% of affected advertisers chose to opt out.[449]

[445] Design Doc, "Poirot Design Doc" (Apr. 25, 2017), GOOG-DOJ-13627809, at -809.

[446] *See* Presentation, "Bidding in adversarial auctions" (Nov. 27, 2017), GOOG-DOJ-05282625, at -636 to -637; Design Doc, "Poirot Design Doc" (Apr. 25, 2017), GOOG-DOJ-13627809, at -811 ("Our optimization problem can be stated as follows: For each advertiser, find bidding policy [redacted]

[447] *See* Declaration of N. Jayaram (Aug. 5, 2023), GOOG-AT-MDL-008842383, at ¶¶ 33, 36 ("Before Google transitioned to a Unified First Price Auction, Poirot determined that reducing bids into AdX did not increase expected advertiser surplus by more than the 10-percent threshold, so Poirot did not lower DV360 bids into AdX. […] Since September 2017, Poirot has applied on AdX and on all third-party ad exchanges on which DV360 bids."); Deposition of N. Jayaram at 274:9-13 (Sep. 17, 2021), GOOG-AT-MDL-007173084, at -358 ("A. Google's buy side algorithms run across all the traffic. So that—whether it's AdX or third-party exchanges, the algorithm that we are talking about [Poirot] applies on all the traffic for DV360.").

[448] *See* Design Doc, "Project Poirot" (Mar. 31, 2017), GOOG-DOJ-11247631, at -631 ("We're proposing to add a checkbox at partner level with per-advertiser option to opt-out"); Email from [redacted] to [redacted], "Re: [Update] Project Poirot stats" (May 3, 2017), GOOG-DOJ-12025827, at -827 ("As part of step 2, we'll communicate to advertisers and they'll have the option to opt out. This will happen before full launch, which is step 3.").

[449] *See* Presentation, "Bidding in adversarial auctions" (Nov. 27, 2017), GOOG-DOJ-05282625, at -644 ("Very few customers [redacted]%) opted out.").

2. How Poirot Experimented to Identify Non-Second-Price Auctions and Optimize Bids

225. Poirot used experiments to determine non-second-price auctions and optimize bids. The first version of Poirot performed this experiment-and-optimize process separately for each advertiser and each exchange.[450] Every day, for a subset of the advertiser's traffic to each exchange, Poirot tested bids between [redacted]% and [redacted]% of the advertiser's reported CPM and estimated the advertiser surplus for each multiplier that it tested in that range.[451] It then fit a curve to the results of these experiments, such as the one shown in Figure 6, and identified the bid multiplier that maximized the advertiser's expected surplus.[452] If the exchange was using a second-price auction, economic theory predicts that the multiplier maximizing the advertiser's expected surplus should be 1 (resulting in bids equal to advertiser values), reflecting the fact that the second-price auction incentivizes a bidder to bid its value for an impression. If Poirot found that a different multiplier significantly increased the advertiser's expected surplus, that would suggest that the exchange was likely to be using a non-second-price auction.

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[450] *See* Design Doc, "Poirot Design Doc" (Apr. 25, 2017), GOOG-DOJ-13627809, at -812 ("Per-exchange is the minimum requirement […] Customer id is [also] used"); Presentation, "Poirot Review" (Jun. 10, 2019), GOOG-DOJ-32261273, at -279 ("Surplus Change vs. Bid Multiplier[:] Measured for each advertiser x exchange, from daily background experiment"). This process was performed unless an advertiser had insufficient traffic to a given exchange to conduct these experiments, as discussed in Paragraph 226.

[451] *See* Design Doc, "Poirot Design Doc" (Apr. 25, 2017), GOOG-DOJ-13627809, at -813 ("We run a nightly data pipeline that gathers the necessary metrics (original bid, cost, impressions) for the relevant slices and use the previous [redacted] days to optimize."); Presentation, "Poirot Review" (Jun. 10, 2019), GOOG-DOJ-32261273, at -279 ("Surplus Change vs. Bid Multiplier[:] Measured for each advertiser x exchange, from daily background experiment"); Design Doc, "Poirot v2.0" (Aug. 10, 2018), GOOG-DOJ-12059682, at -682 ("Current Poirot Version […] Methodology: [redacted]

[452] *See* Design Doc, "Poirot Design Doc" (Apr. 25, 2017), GOOG-DOJ-13627809, at -813 [redacted]; Presentation, "Poirot Review" (Jun. 10, 2019), GOOG-DOJ-32261273, at -279 ("Surplus Change vs. Bid Multiplier[:] [redacted]

Figure 6: Poirot multipliers and advertiser surplus.[453]

226. Because this process involved daily experiments for each advertiser on each of several exchanges, the number of experiments created the likelihood of **false positives** in which random statistical noise might lead the test to wrongly conclude that a second-price exchange was using a non-second price format. Poirot included two protections to reduce the likelihood of this error. *First,* if an advertiser had insufficient traffic to a given exchange to conduct the Poirot experiments with sufficient statistical confidence, DV360 used a default multiplier for that exchange, calculated using an experiment conducted on DV360's overall traffic to the exchange.[454] As I discuss in Paragraph 235 below, a later update to Poirot removed advertiser-specific optimizations altogether, opting instead to use data collected at the exchange level. *Second*, Poirot adjusted bids only if the

[453] Presentation, "Poirot with auction type signal" (Nov. 5, 2018), GOOG-DOJ-05283173, at -175.

[454] *See* Presentation, "Poirot Review" (Jun. 10, 2019), GOOG-DOJ-32261273, at -289 to -290 ("Exchange priors (used if insufficient data for given advertiser)").

experiment found that the optimal multiplier would increase advertiser surplus by at least [redacted]%. Google set the [redacted]% threshold to "avoid changing bids on second-price auctions due to noise in the data" because engineers "want[ed] to be confident [that] an exchange is unclean before lowering bids on it."[455] Based on this threshold, the Poirot algorithm typically chose to submit bids unadjusted into exchanges it predicted to be running second-price auctions, including AdX (then using a second-price auction format) and the Improve Digital and United ad exchanges (and potentially other exchanges, as well).[456]

227. For concreteness, suppose that DV360 experiments on a small subset of an advertiser's bids into an exchange, adjusting the advertiser's bids using bid multipliers between 0.6 and 1, and obtains the data on average advertiser surplus displayed in Table 2 below.

Table 2: Example Data on Average Advertiser Surplus

Bid Multiplier	0.6	0.7	0.8	0.9	1
Average Advertiser Surplus per thousand impressions	$0.30	$0.35	$0.35	$0.30	$0.20
Surplus Relative to Bid Multiplier 1	1.5	1.75	1.75	1.5	1

228. In this data, bid multipliers less than 1, corresponding to bids less than the advertisers' values, improve advertiser surplus. This suggests that this exchange was unlikely to be

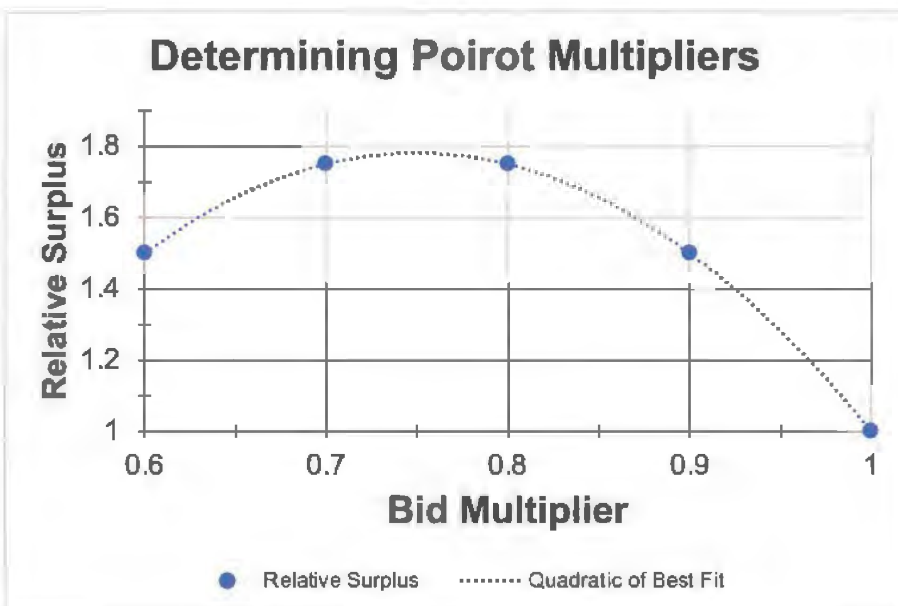
[455] Design Doc, "Poirot Design Doc" (Apr. 25, 2017), GOOG-DOJ-13627809, at -813 ("If the maximum surplus change is less than [redacted]%, we just select [redacted]. This is to avoid changing bids on second-price auctions due to noise in the data; we want to be confident than an exchange is unclean before lowering bids on it."). *See also* Declaration of N. Jayaram (Aug. 5, 2023), GOOG-AT-MDL-008842383, at ¶ 30 ("If a multiplier increased the expected advertiser surplus by less than 10 percent, then Poirot would not adjust the advertiser's bids into that ad exchange. The purpose of this [redacted]-percent threshold was to avoid adjusting bids on second-price auctions that might erroneously appear to be non-second-price auctions due to noise in the data.").

[456] *See* Presentation, "Bidding in adversarial auctions" (Nov. 27, 2017), GOOG-DOJ-05282625, at -641 to -642.

using a clean second-price auction format because clean second-price auctions have optimal bid multipliers of 1.

229. Under Poirot v1, DV360 would calculate the best-fitting quadratic curve for this data, as illustrated in Figure 7. It would then identify the bid multiplier that maximizes the relative surplus using that curve, which is 0.75 for this data. Poirot would then multiply the advertiser's subsequent bids into that exchange on that day by 0.75.

Figure 7: Example calculation of Poirot bid multipliers[457]



3. Poirot Increased Advertiser Surplus

230. Google studies confirmed that this first version of Poirot benefited advertisers. Two internal studies estimated that Poirot increased advertiser surplus on non-second-price

[457] This figure was created from [redacted] in my supporting materials. The figure is saved in [redacted]

exchanges by [redacted]%.[458] A similar internal study found that Poirot increased advertiser surplus by [redacted]% in total for all exchanges, including second-price exchanges.[459]

231. Poirot shaded bids only enough to maximize advertiser surplus. If DV360's goal was to reduce spending on competing exchanges, it could have shaded bids beyond the point that Poirot determined to be optimal, but it did not do that. Moreover, the Poirot procedure did not apply differently to exchanges that participated in header bidding.[460] These observations are inconsistent with the interpretation that Poirot was designed to undermine header bidding.

232. Poirot protected advertisers and increased advertiser surplus in two ways. First, its direct effect was to reduce the price of impressions purchased on non-second-price exchanges, including those "dirty" exchanges that were unclear or untruthful in describing their auction formats. Second, the budget saved on those impressions allowed budget-constrained advertisers to bid on and win *more* impressions than previously.[461] Total spending increased on AdX and some non-Google exchanges (including United and

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[458] *See* Email from [redacted] to [redacted] et al., "Re: Poirot to launch 6/19" (Aug. 20, 2017), GOOG-DOJ-07825115, at -115 ("Through experiments, we measured that […] the surplus increases by [redacted]% in the affected exchanges as a result of this launch."); Design Doc, "Poirot Design Doc" (Apr. 25, 2017), GOOG-DOJ-13627809, at -815 ("The following table shows the impact limited to the non-second price auction exchanges."; "surplus […] change[:] [redacted]%").

[459] *See* Presentation, "Bidding in adversarial auctions" (Nov. 27, 2017), GOOG-DOJ-05282625, at -644 ("Advertiser impacts […] [redacted]% surplus increase ($252M)").

[460] Declaration of N. Jayaram (Aug. 5, 2023), GOOG-AT-MDL-008842383, at ¶ 31 ("Poirot's process for calculating multipliers that maximized advertiser surplus did not take into account whether an ad exchange participated in header bidding.").

[461] There may have even been another indirect effect, which is that advertisers may have increased their budgets in response to better value per dollar spent enabled by Poirot.

Improve Digital) but decreased on others.[462] Overall, Google's analysis found that Poirot did not affect advertisers' *total* spend, suggesting that budgets were redistributed.[463] The fact that only [redacted]% of advertisers opted out of Poirot also speaks to advertisers' perceptions of its benefits.[464]

4. How DV360 Updated Poirot to Further Increase Benefits to Advertisers

233. Over time, there were three major updates to the Poirot program.

234. The first, internally called **Poirot with Bid Buckets**, launched in January 2018.[465] This update grouped an advertiser's bids for different impressions into five ranges, known as "bid buckets," depending on the amount of the bid, and calculated different bid multipliers for each (using the same experimentation process described above).[466] This approach helped to implement optimal bid shading in non-second-price auctions, in which auction theory observes that the profit-maximizing bid multiplier can vary depending on the bidder's value. Google's pre-launch experiments anticipated that Poirot

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[462] *See* Presentation, "Bidding in adversarial auctions" (Nov. 27, 2017), GOOG-DOJ-05282625, at -644 ("Exchange impact[:] Overall spend neutral[;] Spend and CPM on dirty auction exchanges dropped by [redacted]%[;] Spend up by [redacted]% on second price auction exchanges").

[463] *See* Presentation, "Bidding in adversarial auctions" (Nov. 27, 2017), GOOG-DOJ-05282625, at -644 ("Exchange impact[:] Overall spend neutral"); Email from [redacted] to [redacted] et al., "Re: Poirot to launch 6/19" (Aug. 20, 2017), GOOG-DOJ-07825115, at -115 ("Overall DBM spend is neutral, indicating no difficulty in redistributing the budgets. Budget reports also do not show any increase in under-delivery.").

[464] *See* Presentation, "Bidding in adversarial auctions" (Nov. 27, 2017), GOOG-DOJ-05282625, at -644 ("Very few customers ([redacted]%) opted out.").

[465] Email from [redacted] to [redacted], "OVERDUE LAUNCH - Please update: [Launch 215784] Poirot: Bid bucket surplus model" (Jan. 10, 2018), GOOG-DOJ-13579782, at -782 ("Launch Date[:] 2018-01-08").

[466] *See* Design Doc, "Summary of Poirot with Bid Buckets" (Jan. 2018), GOOG-DOJ-13619370, at -370-371 ("In this launch, we are adding 1 extra feature to the Poirot model which predicts advertiser surplus as a function of bidding change. This feature is bid_bucket, and it helps capture non-second-pricing from soft floors.").

with Bid Buckets would improve advertiser surplus for fixed CPM traffic by an additional [redacted]% to [redacted]%.[467]

235. The second major update was called **Poirot v2.0**, which launched in September 2018[468] and made four changes to the Poirot algorithm:

a. [redacted]

[redacted] This fourth change

[467] *See* Email from [redacted] to [redacted]," OVERDUE LAUNCH - Please update: [Launch 215784] Poirot: Bid bucket surplus model" (Jan. 10, 2018), GOOG-DOJ-13579782, at -783 ("From 1% experiments: […] Over fixed CPM DBM traffic on all exchanges Surplus [redacted]% […] >From 5% experiment […] Over fixed CPM DBM traffic on all exchanges Surplus [redacted]%."); Design Doc, "Summary of Poirot with Bid Buckets" (Jan. 2018), GOOG-DOJ-13619370, at -371 ("Surplus expt/cntl […] Fixed CPM DBM x external exchanges [redacted]").

[468] *See* Launch Details Spreadsheet, Launch 259738 (Aug. 25, 2023), GOOG-AT-MDL-009644238, at cells C1, C2 ("Launch Date [...] 2018-9-6").

[469] Some exchanges would vary their format on an impression-by-impression basis and report the format to bidders using an "auction type" signal. *See* Presentation, "Poirot with auction type signal" (Nov. 5, 2018), GOOG-DOJ-05283173, at -176 ("Since January 2018, 3PE have started providing the type of auction they are running using bid_request").

[470] *See* Design Doc, "Poirot v2.0" (Aug. 10, 2018), GOOG-DOJ-12059682, at -682 to -683 ("Lower the floor on bid shaving from [redacted] […] Change the model from [redacted] to improve fits and accuracy. […] Remove customer id. Past experiments have shown surplus gains when customer id is excluded from the model").

was adopted after Google engineers determined that [redacted].[471]

Pre-launch experiments of Poirot v2.0 anticipated an increase of surplus for fixed CPM advertisers on non-Google exchanges of [redacted]%.[472] By reducing the prices of impressions won on non-second-price exchanges, Poirot v2.0 allowed advertisers with limited budgets to purchase more impressions.

236. Poirot's third major update was in 2019 after AdX's transition to a unified first-price auction. This update [redacted][475]

[471] *See* Design Doc, "Poirot v2.0" (Aug. 10, 2018), GOOG-DOJ-12059682, at -683 ("Remove customer id. Past experiments have shown surplus gains when customer id is excluded from the model").

[472] *See* Design Doc, "Poirot v2.0" (Aug. 10, 2018), GOOG-DOJ-12059682, at -682 ("On 3PE (third party exchanges) we see an aggregate surplus increase of [redacted]% over all DBM traffic and [redacted]% over Fixed CPM DBM traffic.").

[473] *See* Declaration of N. Jayaram (Aug. 5, 2023), GOOG-AT-MDL-008842383, at ¶ 35 ("Poirot was also updated following Google's shift to a Unified First Price Auction. With the transition to a Unified First Price Auction, Google began providing minimum-bid-to-win data to buyers, and DV360 [redacted].

[474] *See* Design Doc, "DBM HDMI Consolidated" (May 11, 2020), GOOG-AT-MDL-002293467, at -468 ([redacted]

[475] *See* Declaration of N. Jayaram (Aug. 5, 2023), GOOG-AT-MDL-008842383, at ¶ 35 ("Google subsequently updated Poirot to use models built from Google's minimum-bid-to-win data to optimize for [redacted])

237. In September 2018, Google launched Marple,[476] a program on Google Ads that optimized advertiser bids in a similar manner to Poirot. Google Ads (through AWBid) could bid on behalf of advertisers for certain inventory on non-Google exchanges. Marple, initially called "Poirot for AWBid,"[477] performed a similar experiment-and-optimize procedure to increase advertiser surplus for Google Ads advertisers.[478] The initial version of Marple chose bid multipliers to maximize advertiser surplus for each bid bucket on each exchange.[479]

E. Responding to Plaintiffs' Allegations

1. Poirot Benefited Advertisers

238. Plaintiffs and their experts incorrectly assert that Poirot conferred "no actual benefit to advertisers."[480] This allegation is incorrect: Poirot benefited advertisers by protecting them from overbidding into "dirty" auctions and other non-second-price auctions. By

[476] *See* Launch Details Spreadsheet, Launch 258064 (Aug. 25, 2023), GOOG-AT-MDL-009644236, at cells C1, C3 ("Launch Date[…] 2018-9-10").

[477] Design Doc, "Poirot for AWBid Design Doc" (Sep. 10, 2018), GOOG-DOJ-AT-02512863, at -863 ("Motivated by project Poirot, project Poirot for AWBid (A.K.A Marple) aims to provide optimal bidding strategy for GDN advertisers to buy on non-second price exchanges.").

[478] *See* Design Doc, "Poirot for AWBid Design Doc" (Sep. 10, 2018), GOOG-DOJ-AT-02512863, at -864 ("As the first attempt to develop an optimal strategy to adjust the bids for AWBid, we borrow the success of Poirot project and start with the current modeling approach […] of Poirot in production."); Email from [redacted] "[Launch 258064] Project Marple" (Aug. 14, 2018), GOOG-DOJ-15264552, at -552 ("We always knew that some external exchanges deviate from second pricing. We developed an algorithmic framework to detect and quantify this deviation using AdWords data. Using this framework, we have built bid optimizations to protect AdWords advertisers against price gouging in these 'unclean' exchanges. In this launch, in response to exchanges running non-second price auctions, we lower bids for AdWords buyers bidding into these exchanges in an algorithmic fashion. The algorithm aims to find the optimal bid decrease that maximizes advertiser surplus.").

[479] *See* Design Doc, "Poirot for AWBid Design Doc" (Sep. 10, 2018), GOOG-DOJ-AT-02512863, at -864 to -865 ("We then adjust the advertiser's bid in order to maximize the [redacted]

[480] Fourth Amended Complaint ¶ 400. *See also* Expert Report of J. Gans (Jun. 7, 2024), at ¶ 865 ("Poirot resulted in reallocating revenue from rival exchanges to Google's own exchange, which had no benefit to advertisers or publishers.").

choosing bids that maximized advertisers' expected surplus on each impression, Poirot allowed advertisers to pursue *any* campaign objective at the minimum cost. Poirot improved DV360 as a product, performing a bid optimization procedure that advertisers would otherwise want to pursue themselves. Advertisers were given the option to opt out of Poirot, and fewer than [redacted]% of advertisers elected to do so.[481]

239. Plaintiffs allege that "Poirot would typically adjust DV360's bid to avoid [...] providing the rival exchange with meaningful data about DV360's willingness to pay."[482] This, however, is a side-effect of optimal bidding, which competing exchanges should anticipate. If an advertiser ever bids the same amount for an impression in a non-second-price auction as it does for an identical impression in a second-price auction, then it is necessarily a mistake: there is always a way to change its bids to buy the same number of impressions at lower cost. This means that failing to detect a non-second-price auction and to adapt bids is also a mistake.

240. I illustrate how this works for first- and second-price auctions with an example, for which the arithmetic is displayed in Table 3. Suppose some advertiser is bidding $0.50 per thousand impressions in a first-price auction and winning 1.02 million impressions, and that advertiser is bidding the same amount in a second-price auction, winning some other number of similar impressions. Suppose the bidder reduces its bids to win 20,000 fewer impressions in the first-price auction and increases its bids to win 20,000 more in the second-price auction, leaving the total number of impressions it wins unchanged. For

[481] *See* Presentation, "Bidding in adversarial auctions" (Nov. 27, 2017), GOOG-DOJ-05282625, at -644 ("Very few customers ([redacted]%) opted out.").

[482] Fourth Amended Complaint ¶ 400.

simplicity, suppose it accomplishes this by reducing its bid in the first-price auction by, say, \$0.01 while increasing its bid in the second-price auction by, say, \$0.04. On the one million "unchanged" impressions that it continues to win in the first-price auction, but at a lower price, it saves \$0.01 per thousand impressions, or \$10.00 in total, as shown in Table 3. On the unchanged impressions that it continues to win in the second-price auction with its new higher bid, its prices do not rise despite its higher bid, because prices paid for any impression won in a second-price auction *do not depend on the winner's bid*. On the 20,000 "switched" impressions for which it formerly paid \$0.50 per thousand in the first-price auction, it now pays prices between \$0.50 and \$0.54, or about \$0.52 on average—\$0.02 more than it would have previously paid for those impressions. In total, the advertiser pays about \$0.40=\$0.02×20 more than before for the switched impressions, so its net savings is approximately \$9.60.

Table 3: Example Bidding in First-Price Auctions

	A	B	C=AxB
Impression Category	**Impressions** *(in thousands)*	**Savings (loss)** *(per thousand)*	**Money Saved (lost)**
Unchanged (1st price)	1,000	.01	\$10.00
Unchanged (2nd price)	Any number	0	0
Switched	20	(.02)	(\$0.40)
Total			\$9.60

241. Although the numbers in the example are specific, the conclusions are general: the advertiser saves money by reducing its bid into the non-second-price auction and increasing its bid into the second-price auction while winning the same number of impressions. The money saved on the unchanged impressions in the first-price auction is proportional to the number of those impressions, while the additional cost of the switched

impressions is proportional to the number switched. Because the number of unchanged impressions in the first-price auction is so much larger than the number of switched impressions, the advertiser is better off with the revised bids.

242. Plaintiffs also suggest that Poirot was created "ostensibly" to "avoid optimizations that were bad for advertisers."[483] Professor Gans expands this to the remarkable claim that the reallocation of spending under Project Poirot "had no benefit to advertisers."[484] Yet confirming the theory described above, Google's internal studies estimated that Poirot would increase advertiser surplus on impressions purchased through non-second-price exchanges by [redacted]%.[485] As I also described above, Poirot further aided advertisers by performing bidding optimizations that advertisers would otherwise seek to perform themselves. In suggesting that increasing advertiser surplus was merely a pretext for launching Poirot, the Plaintiffs' narratives ignore Poirot's sizable benefits for advertisers.

243. Professor Gans also suggests that Poirot "potentially reduced match quality,"[486] but I see no reason to expect that outcome in either theory or practice. By ensuring that Google Ads advertisers did not overpay for impressions (also allowing budget-constrained advertisers to spend those savings on additional impressions), Poirot would most likely have improved match quality, not reduced it. This is because bidders can use savings

[483] Fourth Amended Complaint ¶ 400.

[484] Expert Report of J. Gans (Jun. 7, 2024), at ¶ 865.

[485] *See* Email from [redacted] to [redacted] et al., "Re: Poirot to launch 6/19" (Aug. 20, 2017), GOOG-DOJ-07825115, at -115 ("Through experiments, we measured that […] the surplus increases by [redacted]% in the affected exchanges as a result of this launch."); Design Doc, "Poirot Design Doc" (Apr. 25, 2017), GOOG-DOJ-13627809, at -815 ("The following table shows the impact limited to the non-second price auction exchanges"; "surplus […] change[:] [redacted]%"). Google experiments found that Poirot increased advertiser surplus by [redacted]% on all exchanges, including second-price exchanges. *See* Presentation, "Bidding in adversarial auctions" (Nov. 27, 2017), GOOG-DOJ-05282625, at -644 ("Advertiser impact […] 6% surplus increase").

[486] Expert Report of J. Gans (Jun. 7, 2024), at ¶ 865.

from Poirot to compete for more impressions, increasing thickness and likely increasing matching quality.

2. Poirot Targeted Non-Second-Price Auctions, Not Header Bidding As Alleged

244. Plaintiffs and their experts allege that Poirot was a scheme to "combat" header bidding,[487] but this inference is inconsistent with the design of Poirot in at least three ways.

245. *First*, Poirot lowered bids to *all* exchanges in which bid reductions were sufficiently profitable, regardless of whether the exchange participated in header bidding. Google's bidding behavior on its own AdX exchange is also consistent with this same principle. Before 2019, bid reductions on AdX were not sufficiently profitable to trigger Poirot. Since 2019, AdX uses a first-price auction, and DV360 computes the optimal bid shading for its advertisers bidding on AdX using the Poirot algorithm.[488]

246. *Second*, Poirot did not shade bids into exchanges that used second-price rules, regardless of whether they participated in header bidding. Typical Poirot experiments did not find any benefits to altering bids on exchanges such as Improve Digital and United, which appeared to be second-price exchanges.[489] Google's internal study found that Poirot

[487] Fourth Amended Complaint ¶ 400; Expert Report of J. Gans (Jun. 7, 2024), at ¶¶ 863-64 ("In addition to the conduct that I have found to be anticompetitive in itself, there were additional actions aimed at limiting the impact of Header Bidding [...] As one example, Google increased barriers to entry through Projects Poirot and Elmo.").

[488] *See* Presentation, "DV360 optimizations ENG deep dive" (Jan. 24, 2020), GOOG-DOJ-11733552, at -579 ("The concepts of Project Poirot were leveraged to let DV360 bid into the AdX first-price auction"); Declaration of N. Jayaram (Aug. 5, 2023), GOOG-AT-MDL-008842383, at ¶¶ 35-36 ("Poirot was also updated following Google's shift to a Unified First Price Auction.").

[489] *See* Presentation, "Bidding in adversarial auctions" (Nov. 27, 2017), GOOG-DOJ-05282625, at -641 to -642. These were either second-price auctions, or sufficiently close to second-price auctions that Poirot did not typically detect a sufficiently large benefit to bid shading.

would increase spending on such non-Google second-price exchanges by [redacted]%.[490] This further suggests that Poirot benefited some competing exchanges.

247. *Third*, Poirot shaded bids only as much as necessary to maximize advertiser surplus and no more, as an objective to "combat" what other exchanges might predict.[491] A program designed to "combat" an exchange might shade bids below the optimum or choose not to bid on it at all, but that is not the effect that Poirot had. Moreover, as I discuss in the subsequent paragraphs, if an exchange changes its auction format and bidders adapt to that change by choosing surplus-maximizing bids, there is no reason to expect *a priori* that the exchange's revenue will fall at all.

3. Plaintiffs' and Their Experts' Theory of Harm to Publishers and Competing Exchanges Is Based on Faulty Assumptions

248. Plaintiffs claim that Poirot aimed to limit the scale of competing exchanges.[492] Plaintiffs also point to internal documents projecting that "non-second price exchanges [would] see a revenue drop in the range of [redacted]% … Overall [DV360] revenue impact is [redacted]%" as part of a proposed theory of harm to publishers and competing exchanges.[493] Professor Gans similarly argues that "Poirot [...] made it more difficult for rival exchanges and

[490] *See* Design Doc, "Poirot Design Doc" (Apr. 25, 2017), GOOG-DOJ-13627809, at -815 to -816 ("Assuming that we continue to spend all budgets, the following table shows the impact once the budget server adapts. […] Clean 3p DBM revenue […] [redacted]%").

[491] *See* Design Doc, "Poirot Design Doc" (Apr. 25, 2017), GOOG-DOJ-13627809, at -811 ("Our optimization problem can be stated as follows: For each advertiser [redacted] Presentation, "Bidding in adversarial auctions" (Nov. 27, 2017), GOOG-DOJ-05282625, at -633 ("Most advertisers and agencies using DBM, however, don't have the technology and sophistication needed to combat adversarial SSPs.").

[492] Fourth Amended Complaint ¶ 401 ("Google's main goal was depriving rival exchanges of sufficient scale.").

[493] Fourth Amended Complaint ¶ 401 ("Initial experiments regarding the effect of Poirot actually showed a negative revenue impact to DV360, but Google's main goal was depriving rival exchanges of sufficient scale engaged in header bidding to compete with Google's ad exchange…").

entrants to compete," because it "resulted in reallocating revenue from rival exchanges to Google's own exchange."[494] There are two errors in the Plaintiffs' theory of harm to competing exchanges.

249. *First*, Poirot was not designed to harm competing exchanges: in fact, non-Google exchanges running second-price auctions would expect to see *increased* spending as a result of Poirot. Plaintiffs neglect to include the other finding in the document quoted in the Complaint that "[c]lean exchanges overall [would] see [redacted]% revenue increase."[495] This could be expected as a result of the fact that Poirot helped advertisers avoid overpaying for impressions, so that the spending saved by purchasing impressions at a lower price could be spent on other impressions. Google engineers expected this would occur, writing, "we expect the budget server to react quickly to adjust impression probabilities and bring [budget-constrained advertisers] back up to spending their budgets."[496] Indeed, post-launch studies found that the projected revenue drop "didn't materialize after launching," which is consistent with advertisers reallocating cost savings to the purchase of additional impressions. After incorporating these changes, Google studies showed that Poirot increased spending on competing second-price exchanges by [redacted]%. Even if advertisers chose not to spend the Poirot cost savings in this way, Poirot still increased the average profitability of each impression acquired, resulting in a net increase in total

[494] Expert Report of J. Gans (Jun. 7, 2024), at ¶ 865.

[495] Design Doc, "Project Poirot" (Mar. 31, 2017), GOOG-DOJ-11247631, at -631.

[496] Design Doc, "Poirot Design Doc" (Apr. 25, 2017), GOOG-DOJ-13627809, at -814. To understand how this effect could occur, imagine that, without Poirot, an advertiser had a $100 budget and won 1000 impressions, for an average cost per impression of $0.10. Optimal bidding under Poirot into an exchange using non-second-price auctions might allow the advertiser to win the same 1000 impressions for a lower average cost per impression of, say, $0.09, leaving $10 left in the advertiser's budget, which could be used to purchase an additional 111 impressions at that same average cost.

advertiser surplus.

250. *Second*, any harms to non-second-price exchanges rely on the Plaintiffs' persistent (but faulty) assumption that advertisers do not change their bids in response to changing incentives. Poirot was a free service to DV360 advertisers and, in its absence, advertisers would be incentivized to pursue their own bid optimization programs and these would most likely be less efficient than the one that DV360 designed. Such self-service is the relevant comparison to assess the effects of programs like Poirot, not the Plaintiffs' fictitious but-for world in which advertisers do not respond to incentives.

251. In the absence of programs like Poirot, advertisers that continued to report the same fixed CPMs to DV360 despite exchanges transitioning away from second-price auctions would experience large reductions in their profits from online display advertising. For example, an advertiser that used DV360 to bid into an exchange that suddenly transitioned from using a second-price auction to using a first-price auction would notice—in the absence of Poirot—that it suddenly started paying more for impressions than it did before: in particular, a price equal to its bid. If that bid was optimized for a second-price auction, so that it equaled its value for the impression, the advertiser would suddenly find itself earning *zero* advertiser surplus on the impressions it won. Clearly, that advertiser would be incentivized to respond, either by excluding that exchange or by reducing the fixed CPM it reports to DV360 to use for bidding.

252. Additionally, without a service like Poirot, each advertiser would face the complex task of identifying optimal bids on its own, which would require costly experimentation and engineering resources. Such experimentation was made more complicated by the

presence of exchanges using dirty auctions, which sought to obscure their auction rules. Even so, at around the time Poirot was introduced, other buying tools had already started to develop bid optimization programs for non-second price exchanges.[497] Many DSPs including [redacted], The Trade Desk, MediaMath, [redacted], [redacted] implemented programs similar to Poirot, indicating that bid optimization is perceived as a valuable service for advertisers.[498]

253. Poirot made bidding easier for DV360 advertisers by performing bid optimizations for them, and more efficiently. DV360 and other DSPs could adapt bids to more information than any single advertiser observes, allowing them to bid more efficiently on behalf of their advertisers than any individual advertiser could do on its own. In this way, Poirot (and similar programs used by other buying DSPs) reduced both the costs to advertisers of optimizing their bids and the likelihood of bidding errors.

[497] *See* Sarah Sluis, "Big Changes Coming To Auctions, As Exchanges Roll The Dice On First-Price," AdExchanger (Sep. 5, 2017), https://www.adexchanger.com/platforms/big-changes-coming-auctions-exchanges-roll-dice-first-price/ ("To combat price increases, some buyers have already started shading, or reducing bid prices. But that strategy comes with its own risks: Buyers will lose out on inventory they want if they submit too low a bid and the auction turns out to work with second-price logic.").

[498] *See* Presentation, [redacted] *See also* Sarah Sluis, "Everything You Need To Know About Bid Shading," AdExchanger (Mar. 15, 2019), https://www.adexchanger.com/online-advertising/everything-you-need-to-know-about-bid-shading/ ("The Trade Desk charges a fee for Koa, its bid shading algorithm, where it pockets a percentage of how much buyers save on each impression. MediaMath also developed bid shading capabilities.").

254. To assess any harms of Poirot to publishers and non-second-price exchanges, a more revealing question is whether Poirot caused the payments to exchanges using non-second-price auction rules to fall, on average, below the payments for similar impressions on a second-price exchange. Auction theory suggests that the answer is "no." In the standard independent private values auction model (adopted by Plaintiffs' experts for their analysis[499]) the celebrated **Revenue Equivalence Theorem** implies that the average revenue for publishers and exchanges is the same with profit-maximizing bids (which Poirot was designed to achieve) in a first-price auction as in a second-price auction.[500] Poirot helps advertisers to bid optimally but would not be expected to reduce other exchanges' average prices below the same market-clearing level that is achieved by second-price auctions.

255. I present an especially simple example to illustrate the power of this *revenue equivalence* idea. Suppose that there are two bidders: Bidder 1 with a value of $1.00 CPM for each impression, and Bidder 2 with a value of $2.00. Each bidder knows its own value but not the other's value. Suppose the publisher floor price is less than $1.00.

256. In a second-price auction, both bidders behave optimally by bidding their values. The seller is paid the value of the second-highest buyer, which is $1.00. In a first-price auction, both bidders could experiment to learn how to bid optimally. Bidder 1 will never experiment by bidding higher than its value of $1.00, because any higher bid can never

[499] Expert Report of M. Weinberg (Jun. 7, 2024), at ft. 62 ("I assume for the majority of this report that the advertisers have independent private values for impressions [...] and it is a sensible assumption to make").

[500] *See* Milgrom, P. R. (2004). *Putting auction theory to work*. Cambridge University Press, at 73-77. *See also* Myerson, R. B. (1981). Optimal auction design. *Mathematics of Operations Research*, *6*(1), 58-73; Klemperer, P. (1999). Auction theory: A guide to the literature. *Journal of Economic Surveys*, *13*(3), 227-86; McAfee, R. P., & McMillan, J. (1987). Auctions and bidding. *Journal of Economic Literature*, *25*(2), 699-738.

yield a positive surplus. Bidder 2's experiments will reveal that it always wins the impression when it bids at least $1.00, so it will learn not to bid more than that. It may also experiment with bids less than $1.00 and find that those bids too often lose the auction. This process of experimentation would ultimately result in Bidder 2 learning to bid just above $1.00 to always win the auctions. The resulting per-impression publisher revenue in the first-price auction will be around $1.00, the clearing price in the second-price auction.

257. For both kinds of auctions, the advertiser with the $2 value eventually learns to bid optimally, winning most of the impressions and paying about $1. Although my example is very simple—it includes only first- and second-price auctions and makes learning easy with its assumption that values do not change from impression to impression—it illustrates a general principle: bid adjustments by optimizing bidders may fully offset the direct effects of changes to auction rules. Omitting bidders' attempts to optimize can mislead, so a full analysis must account for incentives to do so.

4. Poirot Applied Equally to AdX, as Well as to Other Exchanges

258. Plaintiffs claim that Poirot reallocated advertiser spending from dirty auctions to AdX despite it "engaging in the very same auction manipulation."[501] But Poirot applied the same [redacted]% profit threshold to AdX as it did to other exchanges and found that bidding truthfully was an optimal or near-optimal bidding strategy on AdX, and accordingly did

[501] Fourth Amended Complaint ¶ 400 ("Although DV360 was openly critical of 'greedy' rival exchanges that claimed to run a true second-price auction while actually running a 'dirty' second-price auction, Google's own exchange was engaging in the very same auction manipulation [...] Accordingly, DV360 intentionally bid less on rival exchanges and increased bids on its own ad exchange, ostensibly to avoid optimizations that were bad for advertisers, when DV360 was actually redirecting that ad spend to a marketplace that engaged in exactly the same behavior.").

not shade its AdX bids. Similarly, Poirot did not adjust bids into non-Google exchanges such as United and Improve Digital, where optimal bid shading was also predicted to increase advertiser surplus by less than [redacted]%.[502] Indeed, Poirot acted as a limit on AdX's designs, with AdX deciding to reject a version of its Reserve Price Optimization program (RPO) in order to avoid triggering "things like Poirot."[503]

259. Figure 8 displays results from "typical" Poirot v1 experiments, which show the gains from bid shading on different exchanges.[504] While DV360 could add more than [redacted]% to advertiser surplus by shading bids into Pubmatic and OpenX, shading bids into AdX and Improve Digital would add less than [redacted]%. Subsequent versions of Poirot made similar findings.[505]

[502] See typical experiment on these exchanges displayed in Figure 8.

[503] *See* "AdX Dynamic Price Meeting Notes" (Apr. 11, 2018), GOOG-AT-MDL-012701069, at -073 ("Online RPO [:] Three potential less aggressive versions [;] Waiting on gTrade team to let us know which versions are acceptable for Poirot"), -075 ("Online RPO [:] Working on less aggressive version to avoid things like Poirot").

[504] *See* Presentation, "Bidding in adversarial auctions" (Nov. 27, 2017), GOOG-DOJ-05282625, at -641.

[505] *See* Design Doc, "Poirot v2.0" (Aug. 10, 2018), GOOG-DOJ-12059682, at -683 to -684 ("The new poirot [sic] model turns out to be a no-op on AdX similar to the prod model.").

Figure 8: Bid multipliers and advertiser surplus[506]

[redacted]

260. The designs of Poirot are consistent with DV360 offering a service to maximize surplus for its advertiser-customers, rather than to preference Google's AdX exchange. As I discussed in Paragraph 226 above, the statistical threshold used in Poirot made sense as a way to avoid reducing bids on genuine second-price auctions, which would reduce advertiser surplus and might inadvertently harm exchanges using a second-price auction.

[506] Presentation, "Bidding in adversarial auctions" (Nov. 27, 2017), GOOG-DOJ-05282625, at -641.

VIII. DYNAMIC ALLOCATION: USING AUCTIONS TO INCREASE PUBLISHER REVENUES ON REMNANT IMPRESSIONS

A. Overview

261. Dynamic Allocation (DA) was an auction design introduced by DoubleClick in 2007 to improve publishers' sales of remnant impressions.[507] At the time of its launch, DA differed from the dominant payment models of ad networks and the waterfall—a common method used by publishers to allocate remnant impressions—in its use of a second-price auction to determine payments to publishers.[508] Under DA, a publisher could configure DFP to sell a non-guaranteed impression to a bidder on AdX only when it would pay more than the publisher's largest expected payment from any other remnant demand source.[509]

262. As a consequence, on every impression, DA could only increase a publisher's expected revenues compared to a *status quo ante* without bids from AdX. To quantify the effects of DA for publishers and evaluate these effects relative to a wider range of counterfactuals, I conducted a simulation study using GAM and Google Ads auction data from January of 2024. The simulations suggest that average publisher revenues using DA are substantially higher than those obtained using a waterfall, both in the case that AdX is not included in

[507] *See* Presentation, "2008 Strategic Planning DoubleClick Advertising Exchange" (Jul. 26, 2008), GOOG-TEX-00458239, at -247; Presentation, "Ad Exchange Dynamic Allocation" (Sep. 5, 2013), GOOG-TEX-00054839, at -843.

[508] *See* White Paper, "Profiting from Non-Guaranteed Advertising: The Value of Dynamic Allocation & Auction Pricing for Online Publishers" (2010), GOOG-DOJ-06818412, at -413 to -414.

[509] White Paper, "Profiting from Non-Guaranteed Advertising: The Value of Dynamic Allocation & Auction Pricing for Online Publishers" (2010), GOOG-DOJ-06818412, at -414 ("If [AdX] can provide the publisher with a net CPM value higher than they would have gotten from delivering their directly booked, non-guaranteed ad, [AdX] will deliver an ad.").

the counterfactual waterfall (a [redacted]% increase) and in the case that AdX would otherwise have been included in the counterfactual waterfall (a [redacted]% increase).[510] In my simulations, DA also expanded output by reducing the number of unsold impressions.

263. Plaintiffs' and their experts' arguments about DA have significant flaws:

a. Plaintiffs and their experts allege that DA steered transaction volume towards AdX.[511] But DA only accomplished that via competition on the merits, delivering what publishers wanted: substantially higher revenues.

b. Plaintiffs' allegations lack historical context, comparing DA to an ahistorical counterfactual in which other exchanges could make real-time bids into DFP.[512] DA improved publisher revenues and allocated impressions more efficiently than the waterfall model that preceded it, which did not make any use of real-time bids.[513] The technology to accept real-time bids from AdX bidders was introduced in 2009 (after DoubleClick's acquisition by Google[514]) with the launch of "AdX

[510] I describe these simulations in detail in Section VIII.E and the technical notes in Section XV.B.

[511] *See* Expert Report of J. Gans (Jun. 7, 2024), at ¶ 548 ("In its implementation of DA after the acquisition of DoubleClick, Google made and maintained critical choices with the intention of steering inventory to its AdX exchange compared to other intermediaries, without providing benefits to publishers."). *See also* Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 120 ("In my opinion, Dynamic Allocation led to higher win rate and higher revenue for AdX as well as lower win rate and lower revenue for non-Google exchanges."); Expert Report of P. Pathak (Jun. 7, 2024), at ¶ 123; Fourth Amended Complaint ¶ 281("Dynamic Allocation was exclusionary and successfully foreclosed competition in the exchange and buying tool markets").

[512] *See, e.g.*, Fourth Amended Complaint ¶ 279 ("Internal Google documents reveal Google's knowledge of its own misrepresentations, stating that the optimal publisher set up in display advertising includes 'real-time bidding across exchanges,' which is 'at scale, at the best possible price, with zero waste.'").

[513] *See* White Paper, "Profiting from Non-Guaranteed Advertising: The Value of Dynamic Allocation & Auction Pricing for Online Publishers" (2010), GOOG-DOJ-06818412, at -413 ("With indirect sales, the CPM is usually fixed, but the number of impressions delivered is not.").

[514] Google, Google Closes Acquisition of DoubleClick, News from Google (Mar. 11, 2008), http://googlepress.blogspot.com/2008/03/google-closes-acquisition-of_11.html ("Google Closes Acquisition of DoubleClick").

2.0," improving efficiency and publisher revenues further.[515] Header bidding, a technology to compare real-time bids from multiple exchanges (discussed further in Section X) did not gain popularity around 2014,[516] years after Dynamic Allocation launched. Designing an "auction of auctions" to compare the highest real-time bids from multiple exchanges natively on Google Ad Manager presented additional challenges, including changing the auction design and helping bidders adapt to that, and Google solved those problems with its rollout of a Unified First Price Auction in 2019 (which I discuss further in Section XIII). Plaintiffs ignore this evolution of the industry over more than a decade and make comparisons of DA technology created in 2007 to outcomes that were possible in 2019.

c. Plaintiffs' and their experts' conclusions are based on analyses that fail to sufficiently account for publishers' incentives to optimize floor prices: when these incentives are properly accounted for, those conclusions change.

B. Online Display Advertising Configurations Prior to DA

264. In the early years of online display advertising, most revenue from online display advertising inventory was generated via negotiated **guaranteed contracts** that fixed a

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[515] *See* Email from S. Woods to S. Feldman, "Re: [Adsense-eng-wat] [Adsense-eng] Re: [Ads-engdirs] Doubleclick Ad Exchange 2.0 - Launched!" (Sep. 19, 2009), GOOG-AT-MDL-010836318, at -318 ("The team has done a great job […] to also go beyond in some very important areas, e.g. […] Real Time Bidding"); White Paper, "DoubleClick Ad Exchange Impact" (Q4 2010), GOOG-DOJ-13247322, at -322 ("The results of our research showed that when DoubleClick Ad Exchange wins the auction, publishers generate [redacted] on average, net of revenue sharing and ad serving fees, compared with fixed upfront sales of non-guaranteed display advertising. […] The Ad Exchange fill rate (percentage of offered impressions resulting in a matched transaction, including those with minimum CPMs or restrictions) [redacted]

[516] Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 13 ("Around 2014, web publishers began to adopt Header Bidding."). *See also* AdPushup, "Header Bidding" (2023), https://www.adpushup.com/header-bidding-guide/ ("Header bidding made it to ad tech somewhere around 2014. And only after one year, in 2015, the technique went viral.").

price and quantity of certain types of impressions.[517] Publishers monetized their remnant impressions (impressions not allocated to guaranteed contracts) using **indirect** sales channels, which in the early years of online display advertising consisted primarily of ad networks.[518] Ad networks would purchase remnant inventory from publishers and package it for sale to advertisers. Publishers would sell advertising space to ad networks on a per-impression basis, with no obligation to fill a minimum number of impressions.[519] Many ad networks paid publishers a fixed price per impression or a fixed proportion of the revenue it earned from advertisers,[520] but did not give publishers control over the ads that would be placed on their websites or the prices they would receive for impressions.[521]

[517] White Paper, "Profiting from Non-Guaranteed Advertising: The Value of Dynamic Allocation & Auction Pricing for Online Publishers" (2010), GOOG-DOJ-06818412, at -413 ("A typical large publisher generates upward of [redacted]% of its online advertising revenue from guaranteed ad sales.").

[518] *See* White Paper, "Profiting from Non-Guaranteed Advertising: The Value of Dynamic Allocation & Auction Pricing for Online Publishers" (2010), GOOG-DOJ-06818412, at -413 ("To tap additional demand from advertisers, brand-conscious publishers often sell through indirect channels, including ad networks, exchanges, and other technology providers").

[519] *See* White Paper, "Profiting from Non-Guaranteed Advertising: The Value of Dynamic Allocation & Auction Pricing for Online Publishers" (2010), GOOG-DOJ-06818412, at -413 ("Publishers usually sell their remaining ad space on a non-guaranteed (or 'pre-emptible') basis through their direct sales channel, as well as through their indirect sales channel, which may comprise a handful of ad network partners. […] With indirect sales, the CPM is usually fixed, but the number of impressions delivered is not."); "AFC Partnerships" (Jan. 7, 2008), GOOG-DOJ-03516570, at -575 ("Today, most large publishers […] rely on ad networks like AFC to fill remnant inventory.").

[520] White Paper, "Profiting from Non-Guaranteed Advertising: The Value of Dynamic Allocation & Auction Pricing for Online Publishers" (2010), GOOG-DOJ-06818412, at -413 ("Ad networks provide revenue to publishers willing to commit, in advance, a large number of impressions at a fixed CPM value.").

[521] *See* David Kaplan, "On Ad Networks: Pork Bellies, Diamonds, Or The New Direct Marketing?," Forbes (Apr. 8, 2008), https://www.forbes.com/2008/04/08/online-ad-networks-tech-cx_pco_0408paidcontent.html?sh=7414ef02cb8e ("All ad networks are not created equal: If all sides can agree on one thing, it's the need for greater clarity to what's being sold and where it's being placed. […] 'In a lot of cases [in terms of ad nets' handling of remnant, or unsold ad inventory], the buyer doesn't really know what they're getting. And the seller doesn't have any control over price.'"). *See also* "Ad Networks," AffiliateSeeking.com (captured on Jan. 16, 2008) https://web.archive.org/web/20080116101025/https://www.affiliateseeking.com/list/23000001/1.html (listing some examples of ad network pricing options).

265. At times, an ad network might not have a relevant ad to fill a publisher's impression. Ad networks developed the capability to **passback** an unwanted impression, allowing the publisher to offer it to other demand sources.[522] This capability led to the **waterfall**, in which a publisher specifies a list of demand sources to be sequentially offered the opportunity to fill an impression.[523] Under a waterfall, the first demand source was offered the opportunity to fill an impression. If that demand source declined to fill the impression, the request was passed back to the next demand source on the publisher's list, with the process repeating until the impression was sold or the publisher's list was exhausted (or a timeout limit was reached), leaving the impression unsold. The waterfall was a highly configurable process, with publishers free to set the order of consideration and floor prices for each demand source however they wished. Because publishers often did not know whether an ad network would have an eligible ad for the given impression, or what the ad network would pay if it did have an eligible ad, a common approach was to prioritize ad networks in the waterfall with the highest historical average payouts per impression.[524]

[522] Presentation, "Ad Manager Ecosystem 101" (Jun. 2019), GOOG-DOJ-AT-02199478, at -503.

[523] Maciej Zawadziński and Mike Sweeney, "What is Waterfalling and How Does it Work?," Clearcode Blog (Aug. 20, 2021Sep.), https://clearcode.cc/blog/what-is-waterfalling/ ("Waterfalling gets its name from the waterfall-like process for selling inventory—i.e. the demand sources are initiated one at a time, one after another. […] the publisher first tries to sell its inventory via direct sales, as these generally offer the highest cost-per mille (CPM). If it is unable to do so, the publisher will then pass the impression down the waterfall to various ad networks until it is sold."); Presentation, "Ad Manager Ecosystem 101" (Jun. 2019), GOOG-DOJ-AT-02199478, at -503.

[524] *See* Maciej Zawadziński and Mike Sweeney, "What is Waterfalling and How Does it Work?," Clearcode Blog (Aug. 20, 2021Sep.), https://clearcode.cc/blog/what-is-waterfalling/ ("Publishers, however, started running into problems when their chosen ad network wasn't able to sell all of their remnant inventory, which meant their available ad spaces were being left unfilled, leading to missed revenue opportunities. In an effort to increase fill rates and capitalize on revenue opportunities, a process known as waterfalling started to emerge."); White Paper, "Profiting from Non-Guaranteed Advertising: The Value of Dynamic Allocation & Auction Pricing for Online Publishers" (2010), GOOG-DOJ-06818412, at -413 ("Some publishers manage yield across this ad space by manually prioritizing which ad networks access it in order of their relative average CPM payout.").

266. In a waterfall, if a publisher does not know which demand sources are interested in purchasing any particular impression but knows exactly the prices each interested source would pay, then it can maximize its revenue by ordering the waterfall list from the highest price offer to the lowest. But when the prices from different demand sources are not known, for example because they are set by separate auctions within each ad network, then no waterfall process can guarantee selling to the highest bidder: the publisher cannot know whether another buyer lower on its list would have bid more. With uncertainty about price offers, the publisher is incentivized to reject some bids from demand sources near the top of the waterfall, even if the same bids would be accepted from sources near the bottom of the waterfall. The publisher can implement that policy by setting *higher* minimum prices nearer the top of the waterfall.

267. Even so, by offering each impression *sequentially* to ad networks, the waterfall procedure could leave value on the table. Under the waterfall, an impression might be assigned to an advertiser on Ad Network A with a lower value for the impression than an advertiser on Ad Network B, merely because Ad Network A had a higher priority in the publisher's waterfall. That was in large part because, at that time, the prevailing technology did not permit an efficient "real-time" auction among different demand sources. Publisher revenue and advertiser surplus could *both* increase by reallocating the impression to the advertiser on Ad Network B at some higher price than Ad Network A paid, if the technological limitations that existed at the time could be overcome and standards for interoperability could be established.

C. DA Introduced Auctions for Impressions, Improving Platform Thickness and Increasing Publisher Revenues

268. **Dynamic Allocation**, introduced in 2007,[525] improved the allocation by replacing the *sequential* logic of the waterfall with the *simultaneous* comparison of bids from advertisers, ad agencies and ad networks participating in a real-time auction on AdX. In the version of AdX that existed when DA was introduced, participating demand sources would enter bids in advance of auctions, with each bid containing targeting criteria that told AdX the types of impressions that the demand source was interested in purchasing at the specified bid amount.[526] In DFP, publishers would codify information about their non-AdX sources of remnant demand using non-guaranteed line items, which also contained targeting criteria and a **value CPM** (also known as a **static bid**), which DFP used to represent that source of demand in the DA process.[527]

269. DA used a two-step procedure to allocate remnant impressions. First, it would identify the eligible non-guaranteed line item with the highest value CPM: Google engineers called this static bid the **DFP booked price**.[528] Then, AdX would run a second-price

[525] Presentation, "2008 Strategic Planning DoubleClick Advertising Exchange" (Jul. 26, 2008), GOOG-TEX-00458239, at -247 ("Q3'07 Dynamic Allocation.").

[526] DoubleClick, "Ad Selection Specifications for Ad Server Version 14.1" (Mar. 27, 2007), GOOG-AT-MDL-007374059, at -136 ("Buyers can bid on ad slot inventory by indicating their preferred targeting elements and specifying an associated CPM based bid.").

[527] In the original version of AdX, prior to the acquisition by Google, the terminology was a little different: line items were just 'ads' and value CPMs were just 'bids,' but to avoid confusion with other places in this report, I will adopt Google's terminology. *See* DoubleClick, "Ad Selection Specifications for Ad Server Version 14.1" (Mar. 27, 2007), GOOG-AT-MDL-007374059, at -136; DoubleClick for Publishers, "Terminology differences with DART," DoubleClick for Publishers Help (captured on Feb. 11, 2012), https://web.archive.org/web/20120211164005/http://support.google.com/dfp_premium/bin/answer.py?hl=en&answer=158833.

[528] Presentation, "Ad Exchange Dynamic Allocation" (Sep. 5, 2013), GOOG-TEX-00054839, at -843 to -854; Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶¶ 10-12.

auction using the bids it received from advertisers on AdX with a floor price at least as high as the DFP booked price.[529] The AdX bidder with the highest bid would be allocated the impression, as long as that bid was above the floor price; otherwise, the impression was allocated to the demand source associated with the best non-guaranteed line item. If that demand source had no ad to serve, it might pass the impression back to other demand sources in a waterfall. DA was backward compatible: a publisher could adopt DA without major changes to its existing relationships with ad networks.

270. By using a second-price auction to allocate impressions, DA eliminated the possibility of inefficient allocation among the bidders in the auction and ensured that the publisher received a price for the impression that no other AdX bidder was willing to beat. But DA had another important feature in its design in recognition of the fact that publishers had other potential demand sources for their remnant impressions: a floor price in the form of a value CPM set by the publisher.[530] A publisher would be incentivized to set those value CPMs so that the effective floor price for each impression was at least as large as the expected revenue from any non-AdX demand source, ensuring that a bidder on AdX could win only if it paid at least that amount. As long as the publisher did so, DA could increase the expected revenue to the publisher from each impression it sold, but could never reduce it.

[529] If the publisher had otherwise set a floor price for the impression that was higher than the DFP booked price, that floor price would apply. *See* "Adx Queries by Pricing Rule" (Sep. 1, 2016), GOOG-DOJ-13470118, at -118 ("For every query in adx, the price can be determined by the following: [...] PUBLISHER_RESERVE: the reserve set by the publishers[.]").

[530] As Professor Weinberg notes, in addition to using value CPMs, publishers set an explicit floor for AdX; when describing how DA works he writes: "Every lower priority static line item, including AdX, has [...] a price floor [...] DFP calls AdX with reserve price equal to the maximum of [the reserve derived from value CPMs] and AdX's price floor." Expert Report of M. Weinberg (Jun. 7, 2024) at ¶ 113. It is not important for my analysis which mechanism publishers use to set the binding floor prices.

271. A publisher using DA would experience three immediate benefits. *First*, if the publisher was not already calling AdX, then DA allowed it to gain access to a new source of advertising demand. New advertising demand meant new opportunities for publishers to sell remnant impressions, and fewer unsold impressions. *Second*, if AdX had two bidders willing to beat the floor price for DA, then the auction price would exceed the floor, further increasing seller revenues. *Third*, DA gave the publisher a more efficient allocation method to sell display advertising inventory, guaranteed to increase its expected revenues from the sale of remnant impressions compared to using the waterfall with non-Google demand sources alone. By choosing a floor price for each line item that is higher than the expected payment from alternative demand sources (*i.e.*, any demand sources listed in the waterfall that might be triggered if the impression is not sold on AdX), the publisher would earn a higher expected revenue from each impression sold on AdX. This property made DA a *risk-free revenue improvement* for publishers integrating AdX as a new source of demand. An analysis of the first version of DA found that the combined effects of these three benefits of DA increased the revenues that publishers earned per impression sold on AdX by [redacted]%.[531]

272. DA also benefited the advertisers and ad agencies participating in the auctions on AdX: in addition to having access to additional inventory from publishers, they could always win an impression by bidding enough for it, rather than relying on the comparatively non-transparent processes used by ad networks to buy impressions on their behalf.[532]

[531] White Paper, "Profiting from Non-Guaranteed Advertising: The Value of Dynamic Allocation & Auction Pricing for Online Publishers" (2010), GOOG-DOJ-06818412, at -415 ("The results of our research demonstrated that the combined effects of auction pressure and Dynamic Allocation in DoubleClick Ad Exchange resulted in an average CPM lift of [redacted]% compared with fixed, upfront, pre-negotiated sales of non-guaranteed inventory.").

[532] *See* David Kaplan, "On Ad Networks: Pork Bellies, Diamonds, Or The New Direct Marketing?," Forbes (Apr. 8, 2008),

Moreover, the second-price auction ensured that, on each impression won by AdX bidders, the winning bidder paid *only* the amount needed to beat other bids on AdX and the floor price determined by the publisher, and not more, which as I explained before, made bidding simpler for advertisers (see Section III.C.3.a).

D. Real-Time Bidding in AdX 2.0 Further Increased Benefits of DA for Publishers and Advertisers on AdX

273. In September 2009, after its acquisition of DoubleClick, Google redesigned the AdX exchange to further increase the benefits of online display advertising auctions for publishers and advertisers. The redesigned **AdX 2.0** incorporated **real-time bidding** from bidders on AdX and Google's buy-side products (originally just AdWords, but later also DV360).[533] Under real-time bidding, AdX would calculate real-time bids from Google's buy-side products and send a **bid request** containing information about the impression to non-Google bidders on AdX (later called **Authorized Buyers**). After receiving a bid request, bidders would use real-time information (such as ad campaign information and cookies) to determine their bids for the impression, which they would send to AdX.[534]

https://www.forbes.com/2008/04/08/online-ad-networks-tech-cx_pco_0408paidcontent.html?sh=7414ef02cb8e ("All ad networks are not created equal: If all sides can agree on one thing, it's the need for greater clarity to what's being sold and where it's being placed. […] 'Both buyer and seller require transparency. In a lot of cases [in terms of ad nets' handling of remnant, or unsold ad inventory], the buyer doesn't really know what they're getting. And the seller doesn't have any control over price.'").

[533] Email from [redacted] to [redacted], "Re: [Adsense-eng-wat] [Adsense-eng] Re: [Ads-engdirs] Doubleclick Ad Exchange 2.0 - Launched!" (Sep. 18, 2009), GOOG-AT-MDL-010836318, at -318 ("I am extremely thrilled to see AdX 2.0 launch. The team has done a great job not only getting to parity with AdX 1.0 but to also go beyond in some very important areas, e.g. API support, Real Time Bidding, and of course integration with Adsense and Adwords.").

[534] Maciej Zawadziński, "How Does Real-Time Bidding (RTB) Work?," Clearcode Blog (Jul. 2, 2021), https://clearcode.cc/blog/real-time-bidding/ ("The supply-side platform analyzes the information about the user (location, web history, and, if available, age, gender and any other user information) and then sends this information to the ad exchange. Once the ad exchange receives this information, it connects to the demand-side platforms and relays information about the user. The ad exchange starts an auction, and the DSPs then bid on the impression based on what that particular impression is worth to them -determined by predefined parameters set by the advertisers.").

AdX would then run an auction using those bids and return any winning ad to DFP, which served code for the winning ad to the publisher's website. This entire process—from the arrival of the impression to the collection and processing of bids and the presentation of any winning ad—would be completed in the blink of an eye,[535] avoiding slow page load times for end users. Initial reactions from industry players to the launch of AdX 2.0 heralded it as a "watershed moment in the progression towards truly dynamic, demand-driven advertising transactions" and a "positive event for anyone in the exchange space."[536]

274. Real-time bidding improved publisher revenues and the matching of impressions to advertisers. Static bids could leave value on the table for both publishers and advertisers: an advertiser might be willing to pay much more for an impression about which it had accurate real-time information (for example, whether the user had recently visited its website) than it might offer using static bids determined without real-time information. Real-time bidding also allowed a bidder to develop its own methods for determining bids, using any additional information the bidder might have about the impression that it was unable to incorporate into any static bidding system. For this reason, real-time bidding offered potential benefits to both publishers and advertisers.

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[535] Google, "How Authorized Buyers Work With Google Ad Manager," Google Ad Manager Resources (accessed Sep. 27, 2023), https://admanager.google.com/home/resources/how_authorized_buyers_work_with_google/ ("This all happens within around 100 milliseconds.").

[536] Email from [redacted] to [redacted], "FW: comments from industry players on AdX 2.0 on AdExchanger.com this evening" (Sep. 22, 2009), GOOG-AT-MDL-B-003180112, at -113 ("I think everyone is excited to see how [Google] can apply their expertise to the next generation of biddable display."), -113 ("The rollout of Google's updated DoubleClick Exchange offering - and the proliferation of other similar real time bidding platforms - marks a watershed moment in the progression towards truly dynamic, demand-driven advertising transactions."), -112 ("I think the launch of AdX 2.0 is an example of growing the pie as opposed to stealing share from a competitor because it's going to bring lots of new sellers (AdSense and DART for Publisher sites) and buyers (anyone who uses AdWords) into the market. As those sellers and buyers get comfortable with the exchange model I think they'll begin trading on the other platforms as well, so I think this is a positive event for anyone in the exchange space.")

275. To illustrate the potential benefits of real-time bidding over payments based on static bids, suppose that a publisher's best offer from an ad network, say Network X, was a fixed $1 CPM, while an AdX bidder was willing to pay 70¢ three-quarters of the time and $1.50 otherwise. Under DA, the publisher would be incentivized to choose a floor price for AdX of at least $1.00, its best offer from a competing ad network. If the AdX bidder was not able to make real-time bids for the impression, its optimal static bid would be equal to its average value of 90¢.[537] That bid would never win. If instead the AdX bidder can make real-time bids, it could win the impression when its value was $1.50, while the ad network would win the other three-quarters of the time. Whether the publisher, the AdX bidder, or both parties benefit from real-time bidding in this example depends on the floor price chosen by the publisher. With any floor price between $1.00 and $1.50, both the publisher and the AdX bidder benefit.[538]

276. Contrary to Professor Weinberg's conclusion that DA "led to [...] a lower win rate and lower revenue for non-Google exchanges,"[539] some of the benefits of real-time bidding can accrue to non-Google demand sources. To show that, consider the following modification of the previous example. Suppose that Network X continues to offer a fixed $1 CPM payment but the highest AdX bidder instead has a value of $1.50 three-quarters of the time and 70¢ otherwise, reversing the previous probabilities. In the absence of real-time bidding, its optimal static bid would be its average value of $1.30[540] for each

[537] Its average value is 3/4 times 70¢ plus 1/4 times $1.50, which equals 90¢.

[538] With a floor price of $1.00, the publisher would make no additional revenue while the AdX bidder earns surplus from the ads it wins when its value is $1.50. With a floor price of $1.50, publisher revenues increase, while the AdX bidder pays its value, leading to no additional profits.

[539] Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 101.

[540] In this case, its average value is 3/4 times $1.50 plus 1/4 times 70¢, which equals $1.30.

impression, which would always win the auction over the static bid of $1 from Network X. After real-time bidding is enabled, the AdX bidder would only win impressions when it had the higher value of $1.50 (three quarters of the time). In that case, Network X—the network without real-time bidding—would benefit from the transition to real-time bidding, because it would win the impression in the one quarter of cases when the AdX bidder has a value of 70¢. The publisher can also benefit from the transition to real-time bidding in this example by increasing its floor price in the AdX auction above $1.00, extracting more revenues from the AdX bidder when it has a high value for the impression.

277. The preceding examples understate the benefits of DA to publishers since, for simplicity, I have assumed there is only one bidder on AdX. In more realistic examples with multiple AdX bidders, the benefits to publishers would be higher because the AdX winner's price would be the maximum of the floor price and the second-highest bid.

278. To realize the benefits of real-time bidding when many ad networks offered fixed-price payments or revenue sharing to publishers, ad servers needed to adapt their allocation methods to integrate both approaches—a process that was widely understood in the industry to be challenging. OpenX cofounder Jason Fairchild summarized the challenge of unifying live and static demand, saying, "If you think about it, they're two fundamentally different marketplaces. To combine them, you have to rethink even your auction mechanism […] Everything is radically different."[541] DA with AdX 2.0, launched

[541] Josh Ong, "Adtech firm OpenX unveils an industry-changing fusion of real-time bidding and ad networks," The Next Web News (Jun. 9, 2014), https://thenextweb.com/news/adtech-firm-openx-unveils-industry-changing-fusion-real-time-bidding-ad-networks.

in 2009, was Google's answer to this challenge, and other competing exchanges introduced real-time bidding at around the same time.[542]

279. DA with real-time bidding on AdX was an important innovation offering large benefits for publishers. A Google experiment from 2010 found that DA with real-time bids offered publishers an average revenue increase on impressions sold on AdX of [redacted]% compared to pre-negotiated sales of remnant impressions.[543] On average, the experiment found that DA increased *total* publisher revenues over all remnant impressions by [redacted]%.[544] In 2013, Google estimated that DA increased publisher revenues by [redacted]% on each impression it won over an alternative remnant demand source, leading to an overall increase in publisher revenues of [redacted]%.[545] Even so, publishers could have, if they wished, disabled real-time bidding from AdX to restore their pre-DA configurations.[546]

[542] *See* Mike Nolet, "RTB Part II: Supply supply supply!," Mike On Ads (Sep. 19, 2009). http://www.mikeonads.com/2009/09/19/rtb-part-ii-supply-supply-supply/ ("Over the past few months pretty much any aggregator of supply has launched, announced or started work on some sort of RTB capability. All major exchanges — Yahoo's Right Media, Microsoft's AdECN and Google's AdEx have RTB integrations in the works. Of the pub aggregators, AdMeld & PubMatic are live and Rubicon is actively working on a solution. As mentioned, FAN has been live with Myspace inventory for a while and there are a number of other parties, such as ContextWeb, AdBrite and OpenX, entering the space.").

[543] White Paper, "DoubleClick Ad Exchange Impact" (Q4 2010), GOOG-DOJ-13247322, at -322 ("The results of our research showed that when DoubleClick Ad Exchange wins the auction, publishers generate [redacted], on average, net of revenue sharing and ad serving fees, compared with fixed upfront sales of non-guaranteed display advertising.").

[544] White Paper, "DoubleClick Ad Exchange Impact" (Q4 2010), GOOG-DOJ-13247322, at -322 ("Across all pre-emptible inventory, including those instances when the Ad Exchange did not win the auction, the revenue lift for publishers average[redacted]

[545] Presentation, "Ad Exchange Dynamic Allocation" (Sep. 5, 2013), GOOG-TEX-00054839, at -844 ("In these instances when the Ad Exchange won out over the alternatives, the revenue it achieved for that inventory was on average[redacted]% higher than it would have been if the Ad Exchange not been used. This translates to an average overall revenue lift of [redacted]%.").

[546] *See, e.g.*, Summer Livestream Series (Sep. 2019), GOOG-AT-MDL-B-004582905, at -3162 ("You can still exclude specific ad units from dynamic allocation if desired"); Draft Help Center Doc, "DFP and dynamic allocation" (Nov. 16, 2013), GOOG-DOJ-15416614, at -614 ("Dynamic allocation [...] allows Ad Exchange to compete in real time with line items booked in DFP. [...] Publishers configure settings in DFP and Ad Exchange in order to control which inventory is eligible to compete, and how."). Even though I am not aware of earlier references to disabling DA on DFP, it would always be possible for publishers to effectively disable DA—while still using DFP

E. My Simulation Analysis Concludes that DA Improved Outcomes for Publishers and Advertisers

280. In order to investigate the effects of DA on publisher revenues and match rates, I simulated the effects of DA on the sale of over 20 billion impressions. I informed my simulations using real-world data collected from auctions on GAM in the month of January 2024.[547, 548] I compared the outcomes from DA to those obtained under a waterfall, which was the dominant model of remnant ad allocation before the introduction of DA.

281. Simulations complement the theoretical analysis of DA presented in previous sections in two ways. *First*, simulations allow me to *quantify* the possible effects of DA, so that I can assess not only *whether* DA improved publisher revenues and ad fill rates but also *how much* it could have improved those outcomes. *Second*, simulations allow me to judge the likely qualitative effects of DA on publisher revenues and ad fill rates as compared to a wider range of counterfactuals. For example, the theoretical effects of DA I discuss in Sections VIII.C and VIII.D above compare DA to a counterfactual waterfall in which AdX does not participate. Since DA was launched around the same time as AdX, this comparison is likely to have been relevant at that time.[549] In addition, to assess Professor

to allocate ads to other ad networks—by setting a very high value CPM on the highest line item for DFP to beat (much higher than an AdX bidder would bid).

[547] *See* Google Ads Log-Level Dataset (January 2024), GOOG-AT-EDTX-DATA-000000000 to -000258388; Google Ad Manager Log-Level Dataset (January 2024), GOOG-AT-EDTX-DATA-000276098 to -001116097.

[548] The number of simulated impressions is calculated in [redacted] of my supporting materials, with the number saved in [redacted]. Details on each step of the simulation procedure can be found in [redacted].

[549] The DFP ad server first included DA in July 2007, shortly after DoubleClick launched its ad exchange, AdX, in North America. *See* Presentation, "2008 Strategic Planning DoubleClick Advertising Exchange" (Jul. 26, 2008), GOOG-TEX-00458239, at -246 to -247.

Gans' allegations that "[i]n its implementation of DA [...] Google made and maintained critical choices [...] without providing benefits to publishers," and Plaintiffs' allegations that DA "ultimately reduced publishers' yield,"[550] I have used simulations to compare publisher revenues under DA to a different baseline in which all demand sources, including AdX, compete on the same basis using the waterfall.[551]

282. There are several challenges associated with simulating the waterfall and second-price auctions using DA for the time when DA was introduced.

283. The first challenge is to obtain data that is informative about advertisers' values at that time. To analyze the effect of introducing DA, it would be best to have bid or valuation data from 2007, but I am not aware of any such data. To assess the effects of DA, I instead estimated bidders' values for impressions using Google Ads data and GAM auction data from January 2024. The GAM dataset contains bids for around 60 billion US impressions.[552] My analysis used a subset of this data, with my selection criteria described in the Technical Notes in Section XIII.B.2.[553] Because this dataset is from

[550] *See* Expert Report of J. Gans (Jun. 7, 2024), at ¶ 548 ("In its implementation of DA after the acquisition of DoubleClick, Google made and maintained critical choices with the intention of steering inventory to its AdX exchange compared to other intermediaries, without providing benefits to publishers."). *See also* Fourth Amended Complaint ¶ 274 ("Dynamic Allocation ultimately reduced publishers' yield[.]").

[551] As I discuss in Paragraph 25 and Section XIII, an alternative baseline in which all demand sources compete in a unified auction was not technologically feasible at the time of DA's launch and required additional changes to AdX's auction design. For this reason, I focus on the waterfall. Simulations based on the Open Bidding auction design would have led to even higher publisher revenues, for the reasons discussed in Section XIII.

[552] The number of impressions is calculated in code/misc_queries.py of my supporting materials, with the number saved in code/logs/misc_queries.txt.

[553] As I discuss in Section XV.B.2, I analyze the groups of auctions for which the number of observations is large enough to reliably conduct simulations. The resulting subset of data consists of auctions across [redacted] inventory units and [redacted] publishers, comprising approximately [redacted]% of relevant US publisher real-time bidding revenue in the January 2024 GAM data sample. To evaluate outcomes across a range of publisher inventory units, a separate simulation was conducted for each group of auctions. These statistics are calculated in code/misc_queries.py and saved in code/logs/misc_queries.txt. For additional details, see Section XV.B.2.

2024, my simulations could only compare the expected effect of introducing DA to a counterfactual scenario in which *contemporary* bidders instead participated in the waterfall. This may be different from what I would find if I could use data from the relevant earlier period of time. However, the heterogeneity among publishers and inventory units ensure that the data encompasses a wide variety of situations varying significantly in the relative bid strengths of various bidders and participation rates of the demand sources (including AdX).[554] Therefore, the dynamics that would have been at play in some scenarios in the relevant time period of the complaint are likely captured in at least some subset of the 2024 data.

284. The second challenge is to estimate the values advertisers used to inform their decisions in the waterfall. For Google Ads bidders, this estimation was relatively straightforward because the Google Ads dataset contains estimates of bidder values (but the data still needed to be cleaned, filtered, and matched to other auction data, as I discuss in the Technical Notes in Section XIII.B.3). For non-Google Ads bidders, however, the problem was harder because the available data contains only their bids in AdX's first-price auctions, rather than the bidders' actual values. As I have emphasized elsewhere in this report, profit-maximizing bids in first-price auctions are always strictly *lower* than advertisers' values.

[554] For example, for several publishers I simulate, Google Ads makes up a relatively small portion of the revenue coming from the demand sources I simulate: at least [redacted]% of publishers have no more than [redacted]% of their revenue coming from Google Ads, and about [redacted]% of publishers have no more than [redacted]% coming from Google Ads. These results were computed using code/misc_queries.py in my supporting materials, with the numerical values logged in code/logs/misc_queries.txt.

285. I obtained my estimates for non-Google Ads bidders' values using a state-of-the-art empirical economics technique called **bid inversion**.[555] Any method to estimate advertisers' values from the bid data must incorporate one or more assumptions about how bids and values are related. Bid inversion is based on the assumptions that (i) bidders choose the bids that maximize their expected surplus from each auction and (ii) their expectations about the distributions of others' bids correspond closely to the actual empirical distributions. Bids from Google's own demand sources, Google Ads and DV360, are generated in this way, and I would expect that other buying tools would most often choose bids in such a way.[556] An advantage of bid inversion over some other techniques used to estimate bidder values is that it is "non-parametric," which means that it does not restrict the shape of the underlying distributions of bids or values.[557] Bid inversion requires data with a sufficient density of bids in the estimation neighborhood, and that requires that I exclude intervals near the very highest bids.[558] For this study, I do not make point estimates for the highest 2% of values and restrict publishers to set their floor prices so that each demand source fills an impression at least 2% of the time that it is called to bid. I also varied the 2% threshold to 1% and 5%, to check whether other

[555] *See* Guerre, E., Perrigne, I., & Vuong, Q. (2000). Optimal nonparametric estimation of first‐price auctions. *Econometrica*, *68*(3), 525-574. Perrigne, I., & Vuong, Q. (2019). Econometrics of auctions and nonlinear pricing. *Annual Review of Economics*, *11*, 27-54.

[556] *See, e.g.*, Deposition of [redacted] at 369:18-21 (Sep. 17, 2021), GOOG-AT-MDL-007173084, at -453 ("A: We predict the distribution of highest other bid and then we use that information to optimize for advertiser surplus.").

[557] *See* Guerre, E., Perrigne, I., & Vuong, Q. (2000). Optimal nonparametric estimation of first‐price auctions. *Econometrica*, *68*(3), 525-574. The empirical data is a collection of discrete bids. Bid inversion assumes that the bidder fills the gaps between bids to create a smooth distribution of bids-to-beat before computing its optimal bid. I discuss this "bid smoothing" further in Section XV.B.4.b.

[558] This necessity is also highlighted by the cited academic studies, which do not apply bid inversion to extreme bids. *See* Guerre, E., Perrigne, I., & Vuong, Q. (2000). Optimal nonparametric estimation of first‐price auctions. *Econometrica*, *68*(3), 525-574. Perrigne, I., & Vuong, Q. (2019). Econometrics of auctions and nonlinear pricing. Annual Review of Economics, *11*, 27-54.

reasonable thresholds, which could lead to different floor prices, might lead to significantly different effects, and I found that my conclusions about the benefits of DA to be substantially the same. Additional technical details about my empirical approach are described in the Technical Notes in Section XIII.B.

286. The third challenge is to specify which bidders would participate using AdX and which would use other exchanges, and how those participation decisions might have been affected by the emergence of DA. I have seen no data to guide this choice, so for simplicity, I assume that, at the time DA was introduced, the only demand on AdX came from Google Ads bidders. In reality, AdX aggregated bids from many demand sources besides Google Ads, so this assumption underestimates the revenue earned by publishers from AdX in each simulation. I also assume that, to limit latency, a publisher's waterfall could use at most three participating non-Google demand sources.

287. While the first three challenges focus on valuation data, bidders, and their bids, a fourth challenge focuses on the behavior of publishers.[559] The revenues earned by publishers under DA and the waterfall depend also on publishers' floor prices and on the order in which demand sources are called. My simulations compare the waterfall's revenue to the revenue of a separately configured waterfall with DA turned on. To ensure that my estimates of DA's benefits are as conservative as possible, I identify the strongest baseline, which is when the initial waterfall is configured to maximize publisher revenue. Identifying those revenue-maximizing waterfall configurations requires finding the optimal ordering and optimal floor prices for the waterfall separately for each publisher,

[559] Determining the optimal behavior of *bidders* in the simulated AdX auction is not challenging: because each auction is conducted in a *second-price* format, the optimal strategy of each bidder in each auction is to bid its true value.

which is a challenging numerical computation. When I simulate DA, I assume (conservatively) that publishers did not optimize value CPMs exactly and instead selected the floor AdX would face by experimenting with a small set of heuristics. I describe the numerical procedures I used for this in the Technical Notes in Section XIII.B.6.

288. I measure the effects of DA under two different counterfactuals:

a. *Counterfactual 1:* In the first counterfactual, I compare calling AdX with DA to a baseline in which the waterfall would *only* call non-Google demand sources. In this counterfactual, enabling DA brings AdX as a new source of demand for publishers. In the waterfall, I include three inverted non-Google demand sources. I compare outcomes under this baseline waterfall to those that would arise if AdX were called with DA and, if AdX did not win the impression, it would be allocated through a waterfall containing just the two best non-Google demand sources.[560]

b. *Counterfactual 2:* In the second counterfactual, I compare calling AdX with DA to a baseline in which the waterfall includes both AdX (not using DA) and non-Google demand sources. In this baseline waterfall, AdX and three non-Google demand sources all participate using publisher-optimal posted prices. I compare this baseline to the outcome of calling AdX with DA, followed by a waterfall with the same three non-Google demand sources. This comparison isolates the effect of DA's introduction of auction-based pricing.

[560] I reduce the number of non-Google demand sources in the DA simulation to ensure that any increase in publisher revenues caused by DA is not driven by an increase in the total number of demand sources that the publisher accesses. The counterfactual in which the publisher does not displace an existing demand source is covered in Section VIII.C: with an appropriate floor, DA is a *risk-free revenue improvement* for the publisher.

289. I find that DA provides substantial benefits for publishers whether or not they would otherwise have included AdX in their waterfall. DA increases total publisher revenue from remnant inventory by at least [redacted]% compared to a counterfactual waterfall containing AdX. Gains in total publisher remnant revenue are even larger (at least [redacted]%) when compared to the baseline in which AdX does not otherwise participate in the waterfall. The match rate, which is the percentage of all impressions that are successfully sold by the publisher (to AdX or another demand source) also increased in both counterfactuals, from [redacted]% to [redacted]% in Counterfactual 1, and from [redacted]% to [redacted]% in Counterfactual 2. These results are summarized in Table 4 below.

Table 4: Change in Publisher Outcomes on Remnant Inventory After Moving from the Optimal Waterfall to DA[561]

[redacted]

290. Revenue effects naturally varied among publishers. For a complete picture of these effects, I plotted the revenues earned by each publisher with and without DA in Figure 9. In this figure, each point corresponds to a publisher. The horizontal axis is a publisher's simulated revenue under the Counterfactual 1 waterfall (in CPM) and the vertical axis is a

[561] The simulation results are output through code/parse_da_results.py in my supporting materials, with the logs saved in code/logs/parse_da_results.txt. The figures are saved in code/figures/, and the relevant files are prefixed by da_results.

publisher's revenue with DA enabled. The vast majority ([redacted]%) of the points in Figure 9 lie above the 45-degree line (plotted as a dashed line), indicating that most publishers in the simulations experienced an overall revenue increase from DA compared to the Counterfactual 1 baseline. For the majority of publishers, the gains are substantial, with the median publisher experiencing a [redacted]% increase in remnant revenue.

Figure 9: Publisher revenue increases from DA under Counterfactual 1

[redacted]

291. Different publishers also experienced differential effects of DA under the second counterfactual of my simulations. To describe the variations by publisher in Counterfactual 2, I plotted their revenues with and without DA in Figure 10. The interpretation of this figure is akin to that of Figure 9 above: the vast majority of the data

points ([redacted]%) lie above the 45-degree line (plotted). This means that, in my simulations, most publishers enjoyed overall revenue increases from DA compared to the Counterfactual 2 baseline, with the median publisher experiencing a [redacted]% increase in remnant revenue.

Figure 10: Publisher revenue increases from DA under Counterfactual 2

[redacted]

292. I provide more details on my data, modeling assumptions, simulation methodology, and results in the Technical Notes in Section XIII.B.

F. Responding to Plaintiffs' and Their Experts' Allegations

1. Plaintiffs' and Their Experts' Allegations Lack Historical Context and Ignore the Technical Challenge of Designing Unified Auctions

293. Plaintiffs compare DA to a counterfactual in which "exchanges compete at the same time for the impression by returning live, competitive bids,"[562] concluding that DA "ultimately reduced publishers' yield by shielding AdX from real-time competition."[563] Plaintiffs' experts also allege DA was "primarily motivated by Google's desire to maintain an information advantage over other exchanges," and that "Google's Dynamic Allocation [...] distorted the playing field in its favor because Dynamic Allocation was solely granted to AdX and not competing exchanges."[564]

294. These allegations fail in several ways to account for historical context.

295. *First,* DA was a significant improvement when evaluated in the context during which it was created. At the time of DA's launch, it was common for indirect sales channels to offer publishers *fixed* prices.[565] As noted by Professor Weinberg, "[i]nitially, all line items were static, so Dynamic Allocation addressed a natural shortcoming [...]."[566] When a publisher's indirect demand sources offer static prices, DA *must* increase publisher revenue and possibly increase the win-rate of remnant demand sources (for an example,

[562] Fourth Amended Complaint ¶ 270.

[563] Fourth Amended Complaint ¶ 274.

[564] Expert Report of J. Gans (Jun. 7, 2024), at ¶ 549; Expert Report of P. Pathak (Jun. 7, 2024), at ¶ 19.

[565] White Paper, "Profiting from Non-Guaranteed Advertising: The Value of Dynamic Allocation & Auction Pricing for Online Publishers" (2010), GOOG-DOJ-06818412, at -413 ("Ad networks provide revenue to publishers willing to commit, in advance, a large number of impressions at a fixed CPM value.").

[566] Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 104.

see Paragraph 275).[567] Compared to the *status quo ante*, DA allowed real-time competition among advertisers, and according to Google's analysis, it *more than* [redacted] publishers' revenues on non-guaranteed impressions won by AdX.[568]

296. *Second*, in the period that followed the introduction of DA, incorporating real-time bids from additional indirect demand channels would still have required further technological progress, including agreements on applicable industry standards. When DA was introduced, ad exchanges were still nascent and the technology standard for real-time bidding had not yet been developed,[569] as Plaintiffs' experts have acknowledged.[570] At that time, industry participants viewed the main challenge not as exchange interoperability but "driving adoption" and having "sellers and buyers get comfortable with the exchange model."[571] DA eased this transition as it did not displace existing deals

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[567] Suppose the average historical revenue from the best demand source is given by *H* and that the publisher sets a Value CPM, *V* >= *H*, for that demand. After DA, in the case where AdX clears *V*, the publisher must receive at least *H*. In the case where AdX does not clear *V*, the impression is allocated to the best alternative demand source, where the publisher receives at least *H* in expectation. In both cases, the publisher earns at least as much as they were earning before. Professor Weinberg acknowledges this outcome, noting that "[w]hen all other demand sources are static, Dynamic Allocation simply gives the publisher a shot at additional revenue." Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 112.

[568] White Paper, "Profiting from Non-Guaranteed Advertising: The Value of Dynamic Allocation & Auction Pricing for Online Publishers" (2010), GOOG-DOJ-06818412, at -415 ("[A] publisher that generates an average CPM of $[redacted] for its non-guaranteed ad inventory might expect to see $[redacted] by taking advantage of the Ad Exchange.").

[569] Efforts to develop a standard began in November 2010 with the launch of the OpenRTB Consortium. *See* IAB Tech Lab, "OpenRTB" (Jul. 27, 2020), https://iabtechlab.com/standards/openrtb/ ("The Real-Time Bidding (RTB) Project, formerly known as the OpenRTB Consortium, assembled by technology leaders from both the Supply and Demand sides in November 2010 to develop a new API specification for companies interested in an open protocol for the automated trading of digital media across a broader range of platforms, devices, and advertising solutions.").

[570] *See* Expert Report of J. Gans (June 07, 2024), at ¶ 557 ("At the time that DoubleClick developed DA, the demand sources in the Waterfall were networks. Rather than running a real-time bidding auction and returning a live bid, networks simply purchased or did not purchase the impression when called in the Waterfall.").

[571] Email from [redacted] to [redacted], "FW: comments from industry players on AdX 2.0 on AdExchanger.com this evening" (Sep. 22, 2009), GOOG-AT-MDL-B-003180112, at -114 ("Regarding concerns, the biggest challenge for any exchange is driving adoption. It's not always as simple as 'if you build it, they will come'. The exchange represents a rather significant shift in how we typically transact, so adjusting to that for both buyer & seller takes some time."), -112 ("I think the launch of AdX 2.0 is an example of growing the pie as opposed to stealing share from a competitor because it's going to bring lots of new sellers (AdSense and DART for Publisher sites) and buyers (anyone who uses AdWords) into the market. As those sellers and buyers get comfortable with the

between publishers and remnant demand (including demand called by the waterfall), and this backward compatibility made it easy for publishers to adopt. Publishers could also disable DA if they decided it was not to their benefit.[572]

297. If it were even technically possible (which Plaintiffs' experts have not shown), implementing any unified auction in 2007 would also have been a significant organizational challenge, requiring demand sources to coordinate, agree on standards, and coordinate the times of implementation.[573] Such a process would have delayed the transition to a new ad allocation process. Redesigning Google's online display advertising platform to accept bids from other exchanges presented challenges, including the need to integrate bids in different auction formats, to avoid self-competition for bidders bidding on multiple exchanges, and to avoid price-fishing tactics by publishers. Responding to these challenges necessitated further innovations, as I discuss in Section XIII.

298. *Third,* Professor Gans claims that "DA allowed AdX, and only AdX, to compete in real-time against all non-guaranteed inventory, which was priced at a historical, average price, not a live auction price,"[574] but as Plaintiffs' experts and industry media

exchange model I think they'll begin trading on the other platforms as well, so I think this is a positive event for anyone in the exchange space.").

[572] *See, e.g.*, Summer Livestream Series (Sep. 2019), GOOG-AT-MDL-B-004582905, at -3162 ("You can still exclude specific ad units from dynamic allocation if desired."); "DFP and dynamic allocation" (Nov. 16, 2013), GOOG-DOJ-15416614, at -614 ("Publishers configure settings in DFP and Ad Exchange in order to control which inventory is eligible to compete, and how.").

[573] Efforts to develop a standard began in November 2010 with the launch of the OpenRTB Consortium, and support for header bidding was added to the OpenRTB standard in version 2.5, which was adopted in December 2016. *See* IAB Tech Lab, "OpenRTB" (Jul. 27, 2020), https://iabtechlab.com/standards/openrtb/ ("The Real-Time Bidding (RTB) Project, formerly known as the OpenRTB Consortium, assembled by technology leaders from both the Supply and Demand sides in November 2010 to develop a new API specification for companies interested in an open protocol for the automated trading of digital media across a broader range of platforms, devices, and advertising solutions. […] Open RTB 2.5 […] Release highlights include: […] Header Bidding Support - allowing for a signal when a bid request is originated from an upstream decisioning implementation like header bidding").

[574] Expert Report of J. Gans (Jun. 7, 2024), at ¶ 568.

acknowledge,[575] the design of DFP did *not* prevent publishers or other exchanges from using a technology like header bidding to integrate real-time bids as early as the late 2000s.[576]

299. *Finally,* I note that other exchanges competed by offering a similar sales mechanism. For example, the OpenX ad server offered the OpenX exchange the opportunity to win an impression when it cleared the value CPM of the most competitive non-guaranteed line

575 *See* Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 120 ("This is my opinion [...] accounting for periods both when other exchanges participated via the waterfall and when other exchanges participated via header bidding.").

576 *See* Tim Cross, "Who Invented What in Ad Tech? – Part Two," VideoWeek (Jun. 26, 2018), https://videoweek.com/2018/06/26/who-invented-what-in-ad-tech-part-two/ ("Beeswax's Ari Paparo however backs up Brian O'Kelley's claim that he invented header bidding back in 2009, which AppNexus called 'pre-bid.' O'Kelley says the tech was a direct response to a DoubleClick for Publishers feature called 'Dynamic Allocation.' DFP, now owned by Google, allowed Google's own ad exchange AdX to compete against publishers' directly sold campaigns, while other exchanges were only able to compete for impressions not bought either through direct campaigns or AdX. Header bidding was developed as 'a hack around a feature gap in DFP,' says O'Kelley […] Header bidding's use spanned beyond simply countering DFP though, as it emerged as a popular alternative to the 'waterfall' system which offers impressions to demand sources one after the other […] Others however came upon the same idea through different route. Lee Cassingham said that his company Viewex came up with their own header bidding solution as part of a viewability product. Cassingham, having run various businesses within ad tech including an automated programmatic revenue/performance reporting tool, a viewability analytics tool, and an ad ops consultancy, looked for ways to create more value on a publishers' page, and created a 100 percent viewable ad format which appended itself to the bottom of a page. This then inspired a different solution to the viewability problem, where Viewex sought to build a capability for its own ad server whereby it could make viewability-based decisions on a web page before an ad loads. Whilst building the technology Cassingham realised he could capitalise on this pause by adding another step to call a third party to prospect for a higher bid and increase revenues […] Cassingham doesn't claim to have invented header bidding (Viewex's product came out in 2013), but his story provides an interesting example of how the same sort of technology can evolve independently while being built for completely different purposes.").

item,[577] [redacted][578]

2. Plaintiffs' and Their Experts' Allegations About the Purported "Right of First Refusal" Are Incorrect and Fail to Adequately Incorporate Incentives

300. Plaintiffs and their experts allege that DA afforded AdX a "right of first refusal" in which AdX could "peek at the average historical bids from rival exchanges and then transact the publisher's impression if AdX could return a live bid for just a penny more than the highest of these historical bids."[579]

301. This analysis is incorrect for several reasons. Whereas a typical "right of first refusal" grants a party the right to purchase an item under the same terms as a third party,[580] that is not the way that DA operates. Under DA, an AdX bidder needs to clear a value CPM chosen by the publisher in order to win an impression. That value CPM need not represent any other party's offer for that impression, so there is no "right of first refusal."

[577] *See* OpenX, "Selling rules" (Dec. 12, 2016), https://web.archive.org/web/20170708051049/https://docs.openx.com/Content/publishers/userguide_inventory_realtimeselling.html ("If enabled, you can designate inventory to sell through OpenX Ad Exchange using selling rules […] When OpenX receives an ad request for inventory defined by a selling rule, it proceeds with the selection process and selects an eligible line item for the ad space. If the selected line item is for non-guaranteed delivery, before serving the ad for the selected line item, OpenX will give buyers in the real-time bidding exchange the opportunity to bid on the ad space. If a bid is higher than the selected line item, and it matches or exceeds the floor price set for the selling rule, then OpenX serves the ad of the winning bidder, rather than the ad for the line item originally selected by the ad server.").

[578] *See* [redacted]

[579] Fourth Amended Complaint ¶ 271. *See also* Expert Report of J. Gans (Jun. 7, 2024), at ¶ 548 ("AdX was afforded a right of first refusal on publisher's non-guaranteed inventory.").

[580] *See, e.g.*, Kahan, M., Leshem, S., & Sundaram, R. K. (2012). First-Purchase Rights: Rights of First Refusal and Rights of First Offer. American Law and Economics Review, 14(2), 331–371; Choi, A. H. (2009). A Rent Extraction Theory of Right of First Refusal. The Journal of Industrial Economics, 57(2), 252–264.

Furthermore, for inventory on which AdX did bid before other demand sources, the analyses of Plaintiffs and their experts fail to correctly incorporate incentives in two key ways.

302. *First,* in order to support their right-of-first-refusal interpretation, they presume incorrectly and repeatedly that real-time bids from AdX were compared to historical averages from other exchanges.[581] This claim is wrong. Publishers could enter *any* value—not just the exchange's historical average price—as a value CPM. For example, a publisher might configure DFP to assign a value CPM of $2 to a demand source, even though its average payment from the demand source was historically $1. If it did so, then it would not be the historical average price that AdX had to beat.

303. This possibility is not just theoretical: publishers had an *incentive* to set value CPMs *higher* than the historical average revenues of demand sources, and there is evidence that many publishers did just that.[582] Indeed, it is well known that it is *always* optimal for a seller to set an auction's floor price higher than the price it expects to outside the

[581] *See* Expert Report of J. Gans (Jun. 7, 2024), at ¶ 569 ("DA allowed AdX [...] to compete in real-time against all non-guaranteed inventory, which was priced at a historical, average price"). *See also* Fourth Amended Complaint ¶¶ 271 ("Google's Dynamic Allocation program instead had DFP permit AdX to peek at the average historical bids from rival exchanges and then transact the publisher's impression if AdX could return a live bid for just a penny more than the highest of these historical bids."), 274 ("Publishers ranked exchanges to reflect the historical average prices paid by each exchange."), 275 ("With Dynamic Allocation, Google used DFP to allow AdX to swoop in and buy inventory at just a penny more than the depressed average historical bids returned by non-Google exchanges to DFP.").

[582] *See* Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 11 ("Some publishers set Value CPMs higher than their estimates of what CPM a line item would likely generate to increase competitive pressure in the AdX auction or for other reasons."). *See also* "PRD: Unified 1P auction and Pricing rules" (Jul. 25, 2018), GOOG-DOJ-03998505, at -506 ("We've anecdotally heard from some publishers that they inflate the value CPM of remnant line items to try and extract more value from AdX (since the remnant line item can set the reserve price for AdX 2P bids), to make it 'work harder.' [...] Comment [15]: This is based on anecdotal evidence (publisher conversations) - publishers used to do this even before HB was popular.").

auction.[583] Setting a floor price in that way increases the publisher's average revenues by forcing AdX bidders to pay more on average to win an impression.

304. Although Professor Weinberg confirms this incentive, he is dismissive about it, claiming that it would take a "sophisticated" publisher to recognize that it should set a higher floor price for the party getting a first-look at inventory.[584] That is wrong. For publishers, ad revenue is a significant income source, so they can be expected to pay attention to their revenue streams and employ sensible pricing strategies, guided either by analysis or by experimentation.

305. The basic pattern of optimal floor pricing in a sequential mechanism like Dynamic Allocation is not hard for a businessperson to understand. Just as the manager of a clothing store finds it best to set higher prices early in the season and lower prices later in the season to reduce the risk of unsold inventory, a publisher selling impressions finds it best to set a higher price for the first buyer in the waterfall and lower prices for later buyers for the same reason.

306. Even if a publisher sets suboptimal floor prices, the gains from Dynamic Allocation can still be large. In my simulations, when publishers set a floor price *equal* to the historical

[583] *See, e.g.*, Krishna, V. (2010). *Auction theory* (2nd ed.). Academic Press, at 23 ("[A] revenue maximizing seller should always set a reserve price that exceeds his or her value."). For the purpose of the AdX auction run under DA, the publisher's "value" for the impression is its expected revenue from sale of the impression outside of AdX.

[584] *See* Expert Report of M. Weinberg (Jun. 7, 2024), at ft. 114 ("A sophisticated publisher could ignore Google's suggested formulas and set the Value CPMs however they like. If the publisher is sophisticated and revenue-maximizing, they would choose a Value CPM above the default. Throughout the text, I use the term 'sophisticated publisher' with the following context in mind: Publishers can have varying levels of sophistication when attempting to optimize their revenue in the online display advertising ecosystem. On one end, a 'typical' publisher may set parameters according to their ad server's suggested text without developing a detailed understanding of how those parameters are used. At the other end, a 'sophisticated' publisher may fully digest all available documentation and aim to optimize parameters based on their use case, ignoring suggested text. They may even be able to optimize while accounting for the possibility of conduct that is never disclosed in publicly available documentation.").

expected revenue of the waterfall instead of setting them at the optimal, higher level, revenues still increase: by [redacted]% in the first and [redacted]% in the second counterfactuals.[585]

307. Professor Gans justifies his conclusion that "[p]ublishers may incur losses due to AdX's prioritization in DA" with an example that ignores both the functioning of DA and publishers' incentives to set value CPMs higher than historical revenues.[586] In his example, the publisher sets a "CPM rate" of $5 for a non-Google demand source "based on historical performance," and the highest bid in AdX is $4.[587] He claims that "DA's preference for AdX will lead to the impression being served by AdX at $4 rather than passing through it to the alternative demand source."[588] But this is not how DA works: if the publisher sets a value CPM of $5 for the non-Google exchange, AdX would need to have a bidder willing to pay *more* than that amount in order for the impression to be allocated on AdX. Moreover, a revenue-maximizing publisher would set a value CPM *higher* than the historical average revenue of the non-Google demand source, so that, in practice, even a bid on AdX of $5 would likely be insufficient to win the impression.

308. *Second*, Plaintiffs' description incorrectly suggests that AdX adjusted its bids in response to what it learned from "peek[ing]" at the value CPMs setting the floor price.[589] At the

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[585] The calculation of the revenue comparison can be found in code/parse_da_results.py of my supporting materials, with the logs saved in code/logs/parse_da_results.txt. In both counterfactuals, when floor prices were set in this manner, the total publisher revenue under DA reduced relative to the better-optimized floor prices described in Section XV.B.5.

[586] Expert Report of J. Gans (Jun. 7, 2024), at ¶ 575.

[587] Expert Report of J. Gans (Jun. 7, 2024), at ¶ 575 ("For instance, a publisher may set a CPM rate of $3 on AdX and $5 on other exchanges based on historical performance. The highest bid in AdX is $4, whereas the alternative exchange has a unique demand source, bidding $6 for the same impression.").

[588] Expert Report of J. Gans (Jun. 7, 2024), at ¶ 575.

[589] Fourth Amended Complaint ¶ 271.

time that DA was adopted, AdX used a second-price auction, which is a bidder-truthful auction, as I have explained in Section III.C.3.a. That is, a bidder would be incentivized to bid its own value *regardless* of the floor price. In that case, the ability to observe the floor price does not benefit AdX bidders or affect publisher revenues.[590] Indeed, neither DV360 nor Google Ads ever adjusted their bids in response to the auction's floor price in the AdX second-price auction.[591]

309. Plaintiffs claim that AdX could "swoop in and buy inventory at just a penny more than the depressed average historical bids returned by non-Google exchanges to DFP,"[592] which is also misleading, as it misrepresents the operation of DA. Because AdX used a second-price auction, it only paid a "penny more" than the floor price in auctions when there was a single bidder above the floor. In many cases, when two or more AdX bidders cleared the floor, AdX's payment was set by the second-highest bid. In other words, competition in the internal AdX auction could lead to payments to publishers far exceeding the floor price, which is very different from a right of first refusal.

3. Professor Weinberg's Allegations About "Win Rate" and "Ad Quality" Do Not Hold Generally

310. Professor Weinberg acknowledges that DA has two opposing effects on the AdX win rate—namely, that "(a) AdX is always visited first in the waterfall, and (b) AdX's reserve

[590] The descriptions of Google's buy-side DRS, Bernanke and Poirot programs I have seen (and cited elsewhere in this document) suggest that Google's bidding tools did not adapt its bids to floor prices on AdX, as predicted by this theoretical result.

[591] *See* Declaration of N. Jayaram (May 1, 2024), GOOG-AT-MDL-C-000017969, at ¶ 3 ("Before Google Ad Manager transitioned to a Unified First-Price Auction in 2019, Google Ads and DV360 never used a floor price in an auction for an ad impression to adjust the bid values that they would submit for that same ad impression.").

[592] Fourth Amended Complaint ¶ 275

may be increased."[593] Despite this recognition, he reaches the unwarranted conclusion that DA "led to [a] higher win rate [...] for AdX,"[594] even though it is well understood that these opposing effects can result in a *lower* win rate for AdX. As a recent published economic analysis demonstrates, when an exchange such as AdX is called first, the publisher has an incentive to increase the exchange's floor price, sometimes by so much that its win rate *decreases*.[595]

311. In addition to his claims about win rates, Professor Weinberg reasons that, "***[i]f*** it is the case that AdX typically transacts ads that are of lower quality compared to non-Google Exchanges," then DA "would result in lower quality ads displayed on high-value impressions [...]."[596] Professor Weinberg does not provide evidence that ad quality differences between AdX and third-party demand sources were in fact common or significant, and, even if he did provide such evidence, his conclusion does not follow logically from his premise. For the sake of argument, suppose that "AdX typically transacts ads that are of lower quality."[597] In that case, the publisher using Dynamic Allocation could control the average ad quality in several ways, including by increasing the floor price applying to AdX (because doing so would increase the probability that the non-AdX bidder—assumed to be relatively higher quality—would win the impression). As a result, the publisher could determine for itself its optimal tradeoff between prices

[593] Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 121.

[594] Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 120.

[595] Despotakis, S., Ravi, R., & Sayedi, A. (2021). First-price auctions in online display advertising. *Journal of Marketing Research*, *58*(5), 888-907, at "Example 1" on p. 895.

[596] Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 130 (emphasis added).

[597] Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 130.

paid for impressions and ad quality, and depending on the publisher's preferences, the average ad quality could be higher or lower than in the absence of DA.

4. Plaintiffs' and Their Experts' Claims About "Cream-skimming" Are Overstated

312. Plaintiffs and their experts allege that DA permitted Google to "cream skim publishers' high-value impressions."[598] I interpret this claim to mean that DA allowed AdX to purchase impressions that would also have been valued highly by other demand sources, without those demand sources having a chance to bid.

313. Professor Weinberg describes this claim using an example, in which a well-matched advertiser, such as a running-shoe advertiser, bids in real-time through AdX and wins an impression for "a male over the age of 25 who likes running, and has visited ten different shoe company's [sic] websites in the last hour,"[599] over an advertiser bidding through a third-party demand source. There are several issues with his example and subsequent claims.

314. *First*, Professor Weinberg's example describes an atypical case in which all advertisers have high values for the same impression. In the more typical case, as acknowledged by Professor Weinberg,[600] bidders have heterogeneous values for an impression. For example, the end user in Professor Weinberg's example may have a variety of other

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[598] Fourth Amended Complaint ¶ 281. *See also* Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 123 ("When other exchanges primarily participate via the waterfall, Dynamic Allocation, no matter how a publisher sets Value CPMs, would lead to AdX winning an even greater volume of high-value impressions, and increased revenues from these impressions under Dynamic Allocation compared to no Dynamic Allocation.").

[599] Expert Report of M. Weinberg (Jun. 7, 2024), at ft. 156.

[600] Expert Report of M. Weinberg (Jun. 7, 2024), at ft. 62 ("I assume for the majority of this report that the advertisers have independent private values for impressions [...]. This is a simplifying assumption [...], and it is a sensible assumption to make since [...] bidders are heterogeneous in their valuation for impressions (the impression from an avid runner is valued differently by Nike and McDonald's)").

interests that appeal to a broader pool of advertisers: he may have also recently browsed for flights, searched for a local gym membership, researched energy drinks, or searched for diapers for his baby daughter. In that case, the fact that the shoe advertiser bidding through a third-party demand source did not win the impression would more typically indicate that a bidder with a different interest in the end user won, in which case DA may help allocate the impressions to an advertiser with a higher value for that impression. By improving matching, DA increases revenues for publishers and may simultaneously increase the surplus of advertisers.

315. *Second*, Professor Weinberg suggests that publishers cannot use floor prices to effectively mitigate the issue in his example because "[AdX's] static reserve price is set based only on coarse targeting data [...]."[601] But Google Ad Manager does allow publishers to include rich targeting criteria in their line items, including "Custom targeting" that would permit the publisher to integrate live information about the end user's recent interactions with its website.[602] Even in cases where publishers may be unable to incorporate every bit of live information to update the static prices another bidder might offer, publishers could still raise the AdX floor price to offset any *expected* informational advantage that a bidder on AdX might have. Indeed, Google made this easier for publishers via its implementation of RPO, discussed in Section XI.

[601] Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 123.

[602] Google, "Targeting types," Google Ad Manager Help (accessed Jun. 26, 2024), https://support.google.com/admanager/answer/2884033?sjid=5613954590018599404-NC#custom-targeting ("Custom targeting allows you to include key-values, audience segments, or content metadata for video line items if Video Solutions is activated in your network. Key-values in particular can be used for purposes not captured by the built-in targeting in Ad Manager. For instance, you define key-values that identify specific ad inventory on web pages or apps, or they can be used to target ads based on that information you might gather from visitors to your website or app. Key-values, like other targeting, help your advertisers and buyers reach their intended audience or demographic.").

316. *Third,* Professor Weinberg's claims focus on the effects on competitors, rather than the effects on competition. After claiming that DA "would lead to AdX winning an even greater volume of high-value impressions,"[603] he does not elaborate as to how that would damage Google's own publisher-customers or advertisers or the functioning of the wider marketplace. DA has the pro-competitive effect of allowing Google to offer better services to its publisher-customers.

317. Even Professor Weinberg's conclusion that "other demand sources necessarily win a lower volume of these high-value impressions" focuses on the wrong measure.[604] He assesses the *average value* of the impressions won to measure impacts on non-Google demand sources, rather than the demand source's *total surplus*. Even if DA reduced the average value of impressions that a third-party demand source won, that demand source's total surplus might have increased if it transacted more impressions or faced lower floor prices due to its later position. As I demonstrated in an earlier example (see Paragraph 275), DA could make non-Google demand sources better off by increasing the volume and average value of impressions they would win.

[603] Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 123.

[604] Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 123.

IX. ENHANCED DYNAMIC ALLOCATION: INCREASING PUBLISHER REVENUES BY FULFILLING GUARANTEED CONTRACTS MORE EFFICIENTLY

A. Overview

318. Enhanced Dynamic Allocation (EDA) was a Google program to increase publishers' revenues and improve efficiency by allowing real-time bids to compete for impressions that, without EDA, would be allocated to guaranteed contracts. EDA expanded the pool of impressions for which remnant demand (including non-Google demand sources) could compete, dynamically allocating impressions between guaranteed campaigns and remnant demand to increase publisher revenues.[605]

319. At the time of launch, Google described EDA to publishers simply and accurately as a process "designed to increase your Ad Exchange revenue without compromising reservations" by assigning impressions to guaranteed line items "often enough to stay on pace to satisfy its goal."[606] EDA would assign an impression to remnant demand only if it would "pay more than the opportunity cost of not serving the guaranteed line item."[607]

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[605] *See* Comms Doc, "Enhanced Dynamic Allocation" (Nov. 6, 2017), GOOG-DOJ-06885161, at -161 ("Enhanced Dynamic Allocation […] introduces competition between reservations and AdX by allowing AdX (or AdSense) to bid on high priority DFP impressions […] without compromising reservation goals. […] Enhanced Dynamic Allocation increases eCPMs and revenues without compromising reservations.").

[606] "EDA / AdX help articles for review: DFP and dynamic allocation" (Apr. 22, 2014), GOOG-DOJ-15417688, at -691 to -692.

[607] Google, "Delivery basics: Ad competition with dynamic allocation," Google Ad Manager Help (accessed Jan. 8, 2024), https://support.google.com/admanager/answer/3721872?hl=en.

320. Many other ad servers (including [redacted] Magnite, Comcast's Freewheel, [redacted], and OpenX) used technologies similar to EDA to allocate impressions between guaranteed contracts and remnant demand.[608]

321. Plaintiffs' and their experts' description of EDA contains various factual errors:

a. The complaint and Professor Gans assert that EDA offered AdX exclusive access to a new pool of publisher inventory.[609] However, EDA did not expand the pool for AdX bidders alone: it allowed *any* non-Google source of remnant demand

[608] *See* [redacted] Refinitiv Streetevents, "Q2 2021 Magnite Inc Earnings Call" (Aug. 5, 2021), https://investor.magnite.com/static-files/950ded3e-8953-4cf9-a043-d0e72b1fb856, at 4 ("Having a tightly integrated ad server allows for the dynamic allocation of programmatic and nonprogrammatic inventory to provide a holistic yield management solution for publishers."); OpenX, "OpenX transforms concept of SSP with industry-first demand fusion technology" (Jun. 9, 2014), https://www.openx.com/press-releases/openx-transforms-concept-of-ssp-with-industry-first-demand-fusion-technology/ ("Demand Fusion is a patent-pending technology that effectively fuses RTB and network demand, optimizing pricing through superior competition and maximizing revenue for publishers. This groundbreaking approach instantly evaluates all prices and dynamically selects the highest bid from both RTB and ad network buyers within the user's browser to optimize yield for each and every impression."); Ben Munson, "Comcast's FreeWheel launches unified ad decisioning," StreamTV Insider (Apr. 15, 2020), https://www.streamtvinsider.com/tech/comcast-s-freewheel-launches-unified-ad-decisioning ("Comcast's FreeWheel is launching a unified decisioning capability for buyers and sellers to transact across both direct sold and programmatic advertising.").

[609] *See* Expert Report of J. Gans (Jun. 7, 2024), at ¶ 630 ("As I explained above, EDA enables AdX (and only AdX) to transact impressions that would have been allocated to direct deals if it results in a higher clearing price. More specifically, AdX was given the ability to use the highest valued line item price as its reserve price, and transact the impression if it can beat this reserve price. No other exchange has this ability."). Fourth Amended Complaint ¶ 284 ("EDA had the purpose and effect of opening up a new additional pool of publishers' inventory to exactly one exchange: AdX.").

listed as a non-guaranteed line item to win impressions that would previously have been reserved for guaranteed deals.[610]

b. Plaintiffs suggest that EDA enabled Google to run auctions with a "[floor] price Google set for itself."[611] However, as Google told publishers, the EDA price was the outcome of a calculation designed to maximize publisher revenues while ensuring the delivery of publishers' guaranteed contracts. Moreover, EDA did not solely determine the floor price of the auction. EDA added an *additional* floor price, and publishers retained the ability to configure their own floor prices for the AdX auction.[612]

c. Plaintiffs' claim that "Google falsely told publishers that EDA 'maximizes yield,'"[613] is incorrect: EDA *did* maximize publishers' revenues.

322. Plaintiffs contend that EDA "cherry-picked" publishers' most valuable impressions away from direct sales channels.[614] Based on my analysis of Google data on impressions

[610] *See* Comms Doc, "Enhanced Dynamic Allocation" (Nov. 6, 2017), GOOG-DOJ-06885161, at -169 ("How does this affect other remnant line items? Remnant line items continue to function according to dynamic allocation rules - if a remnant [Line Item] (say, a network) has a higher eCPM than AdX, it will still get the impression with this optimization turned on."). *See also* Design Doc, "Uniform Treatment for DFP Remnant and AdX under EDA" (Apr. 2019), GOOG-AT-MDL-011687180, at -180 to -181.

[611] Fourth Amended Complaint ¶ 289 ("Google's exchange could transact the impression if an advertiser returned a net bid greater than both (a) the price Google set for itself and called the 'EDA reserve price' and (b) the average historical bids belonging to rival exchanges.")

[612] *See* Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 22 ("Between the launch of Enhanced Dynamic Allocation in 2014 and the launch of the Unified First Price Auction in 2019, the floor price in AdX was the highest of: (i) the publisher-configured floor price; (ii) the Enhanced Dynamic Allocation price set dynamically based on a temporary CPM (the 'EDA price'); (iii) the price of the remnant line item that was selected as a candidate for the impression; and (iv) the price determined by optimization.").

[613] Fourth Amended Complaint ¶ 291 ("Google automatically turned EDA on for publishers then coaxed publishers into leaving EDA turned on under a false pretense. Wearing its publisher ad server hat, Google falsely told publishers that EDA 'maximizes yield.' Publishers relied upon Google's misrepresentations to enable EDA, thinking it would maximize yield.").

[614] Fourth Amended Complaint ¶ 284 ("EDA had the purpose and effect of opening up a new additional pool of publishers' inventory to exactly one exchange: AdX. Moreover, this new pool contained publishers' most high-value

allocated to remnant demand and direct deals, I find no evidence of "cherry-picking" or "cream-skimming," as suggested by Plaintiffs. Although Professor Weinberg offers an example to support his opinion that "[t]he cream-skimming effect [...] potentially leads to a negative impact on the publisher in the long run,"[615] his example is unrepresentative, as it fails to incorporate the diversity of end user and advertiser interests. Instead, I expect that EDA's better matching would improve the experience for end users, increase revenues for publishers, and likely increase the surplus of advertisers.

B. How EDA Increased Efficiency and Publisher Revenues

1. EDA's Optimization Procedure

323. Prior to Google's introduction of Enhanced Dynamic Allocation, if an impression met the eligibility criteria for one or more guaranteed contracts, it would be immediately assigned to one of those. However, fulfilling guaranteed contracts in this way left money on the table for publishers. As a simple example, suppose that a user had visited Nike's online store, added a pair of shoes to their shopping cart and then left the site before purchasing the shoes. Despite Nike's high willingness-to-pay to show an ad to that user, DFP might assign the user's next impression to the publisher's guaranteed contract with 1-800-Flowers, even though that contract could be fulfilled later with a different impression. In general, a publisher has an incentive to sell an impression to remnant demand sources when they offer the highest price and to fulfill guaranteed contracts with

impressions (e.g., impressions displayed in the most prominent positions of a webpage, impressions targeted to users likely to make a purchase, etc.)."). *See also* Fourth Amended Complaint ¶ 292 ("Internally, Google understood that EDA was a scheme to let its own AdX exchange simply 'cherry-pick [publishers'] higher-revenue impressions,' earning Google's exchange an additional $150 million per year.").

[615] *See* Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 144 ("This cream-skimming effect reduces the value of direct deals with publishers in the long run from the perspective of the advertisers. Hence, it potentially leads to a negative impact on the publisher revenue in the long run.").

the remaining impressions. The publisher does not, however, know in advance which impressions will fetch the highest offers from remnant demand sources.

324. In 2014, Google rolled out **Enhanced Dynamic Allocation (EDA)** to help publishers earn more revenue from remnant impressions by optimizing the selection of impressions used to satisfy guaranteed contracts.[616] At a high level, EDA worked as follows. After determining the best eligible guaranteed contract for an impression, the EDA algorithm calculated an **EDA price** to help allocate the impression.[617] Then, the EDA price served as an additional floor price for AdX and non-guaranteed line items.[618, 619] If no remnant buyer cleared the auction floor price, then the impression was assigned to the guaranteed contract. The EDA price was set to ensure that publisher revenues increased without jeopardizing fulfillment of the publisher's guaranteed contracts.[620] Indeed, by adding a floor price for non-guaranteed demand that was "informed by" the opportunity cost of not

[616] *See* Comms Doc, "Enhanced Dynamic Allocation" (Nov. 6, 2017), GOOG-DOJ-06885161, at -161 ("Generally [*sic*] availability roll-out began on 3/3/2014 […] Enhanced Dynamic Allocation […] introduces competition between reservations and AdX by allowing AdX (or AdSense) to bid on high priority DFP impressions […] without compromising reservation goals. […] Enhanced Dynamic Allocation increases eCPMs and revenues without compromising reservations.").

[617] Design Doc, "Uniform Treatment for DFP Remnant and AdX under EDA" (Apr. 2019), GOOG-AT-MDL-011687180, at -180 ("Enhanced Dynamic Allocation introduces competition between guaranteed reservations and other demand including AdX and DFP remnant reservations, by allowing AdX or DFP remnant to win over high priority DFP guaranteed reservations if it has a higher price than the *opportunity cost* (also called EDA price) set by us.").

[618] Design Doc, "Uniform Treatment for DFP Remnant and AdX under EDA" (Apr. 2019), GOOG-AT-MDL-011687180, at -180 ("Enhanced Dynamic Allocation introduces competition between guaranteed reservations and other demand including AdX and DFP remnant reservations, by allowing AdX or DFP remnant to win over high priority DFP guaranteed reservations if it has a higher price than the *opportunity cost* (also called EDA price) set by us. [...] DFP then ranks the remnant ads and picks one with highest eCPM. The selected remnant ad will be rejected if its eCPM is lower than the EDA price.").

[619] The EDA price was an additional floor price, and the effective floor price of the auction was set equal to the largest of the applicable floor prices (e.g. the EDA price, publisher-set floor price, etc.). Hence, in some instances, the effective floor could have exceeded the EDA price.

[620] Design Doc, "Uniform Treatment for DFP Remnant and AdX under EDA" (Apr. 2019), GOOG-AT-MDL-011687180, at -180 ("The EDA price is calculated in such a way that the DFP guaranteed reservation's delivery goal would not be compromised.").

serving a guaranteed line item, EDA worked similarly to the mechanism Professor Weinberg claims he would implement if he "were to design a waterfall-like format from scratch."[621]

325. To demonstrate how EDA's optimization procedure works, suppose that, over some period of time, a publisher expects to have 3,000 impressions to allocate, of which 2,000 must be assigned to guaranteed contracts, leaving 1,000 impressions for remnant demand. Suppose that, based on historical data, Google estimates that the publisher will receive bids of at least $1 from remnant demand on one-third of its impressions, and bids less than $1 on the remaining two-thirds. If these projections are accurate, the publisher would maximize its revenues on the 1,000 remnant impressions by only selling when the bid it receives is at least $1 and allocating the remainder of the impressions to the guaranteed contract. EDA achieves this by offering *each* impression to remnant demand with the EDA price of $1 as an additional floor price for the publisher. In that way, remnant demand purchases an impression only if it pays at least $1.[622] This results in the guaranteed contract being fulfilled and the set of impressions assigned to remnant demand being the ones with the highest bids from remnant bidders.

326. Implementation of this idea involved some subtle engineering details. One important detail arises because the bids that arrive over time can be forecast only imperfectly, so to

[621] Expert Report of M. Weinberg (Jun. 7, 2024), at ft. 76 ("Prioritization of direct deals over exchanges is a curious feature of the waterfall. If I were to design a waterfall-like format from scratch and I were unconstrained by technological challenges, I would (a) find the maximum payment v I could get from a direct deal for this impression (maybe v = 0, if it satisfies no direct deal targeting criteria), then (b) visit exchanges in the waterfall but setting reserves informed by v"). As Professor Weinberg notes, his suggestion is an idealized one which is "unconstrained by technological challenges." EDA works similarly, but was integrated as an iteration of Dynamic Allocation.

[622] *See* Section XV.C.1 for more detail on calculation of the EDA price, based on Design Doc, "Uniform Treatment for DFP Remnant and AdX under EDA" (Apr. 2019), GOOG-AT-MDL-011687180, at -180-181.

ensure that all guaranteed contracts are fulfilled, AdX needed to track the rate at which guaranteed contracts were being served and update the EDA price adaptively.[623] Continuing the previous example, if the publisher's guaranteed contract was "behind schedule" at some point during the campaign (meaning that EDA had assigned to that contract fewer than two-thirds of the impressions received up until that point), then the EDA price would be increased above $1 and a larger fraction of the subsequent impressions would be assigned to the guaranteed contract. Conversely, if the guaranteed contract was "ahead of schedule" (meaning that EDA had assigned to that contract more than two-thirds of the impressions received up until that point), the EDA price would be reduced below $1. By carefully increasing and reducing the EDA price, Google could eliminate almost any chance that a guaranteed contract would not be fulfilled. As a second important detail, the proper handling of static bids sometimes required randomizing between serving the static bid or the guaranteed contract. I discuss this randomization in detail in the Technical Notes in Section XV.C.1.

2. EDA's Benefits for Publishers

327. Professor Weinberg emphasizes that EDA "led to an increase in win rate and increase in revenue for AdX"[624] and the complaint adds that "EDA hurt publishers' yield."[625]

[623] *See* Google, "DFP and dynamic allocation," DoubleClick for Publishers Help (captured on Sep. 22, 2015) at https://web.archive.org/web/20150922150140/https://support.google.com/dfp_premium/answer/3447903 ("The lower a line item's Satisfaction Index (SI) (that is, the more behind schedule it is), the higher the temporary CPM that's passed to Ad Exchange. Therefore, a standard line item that is behind schedule will win often enough to stay on pace to satisfy its goal and pacing settings.").

[624] *See* Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 101.

[625] Fourth Amended Complaint ¶ 289 ("Moreover, EDA hurt publishers' yield by permitting AdX to transact publishers' impressions for depressed prices. DFP permitted AdX to transact high-value impressions for one penny more than a price floor that Google set for itself—despite Google's obvious conflicts of interest. Google's exchange could transact the impression if an advertiser returned a net bid greater than both (a) the price Google set for itself and called the "EDA reserve price" and (b) the average historical bids belonging to rival exchanges.").

However, the introduction of EDA benefited publishers by increasing their revenues, so any change in AdX's win rate or revenue was competition on the merits: Google won more business by providing a better service to its publisher customers. This is formalized in the following theorem.

328. **Theorem 2:** Suppose that publishers' guaranteed contracts are unchanged after the introduction of EDA and that Google accurately forecasts the distribution of future bids from AdX. Then (1) EDA increases the publisher's expected revenue relative to the pre-EDA allocation procedure, and (2) if publishers set the optimal floor price for the AdX auction ignoring direct contracts, the floor set by EDA *maximizes* publisher revenue.

329. The proof of Theorem 2 is in Section XV.C.2. The intuition for why EDA increases publisher revenues is captured in the example in Paragraph 325 above. Under EDA, guaranteed contracts are still fulfilled, but remnant demand is no longer eligible to purchase an arbitrary selection of impressions—just those for which it is willing to pay most.

330. Moreover, if the EDA price is determined by an accurate forecast of the bids received by AdX and the publisher sets the optimal floor price ignoring direct contracts, the floor price chosen under EDA is optimal: if the EDA price was lower, there would not be enough impressions unsold on AdX to fulfill the guaranteed contract, while if the EDA price was higher (and higher than the publisher-set floor), then more impressions would be unsold on AdX than necessary to fulfill guaranteed contracts, costing publisher revenues. In practice, because Google cannot perfectly forecast the bids for all

impressions, EDA includes an adaptive procedure (discussed in Paragraph 112 above) to revise the floor price as bids are received during a campaign.

331. Google experiments confirm that EDA increased publisher revenues. Around the time of EDA's launch, a Google experiment found that "[t]ypically publishers see [redacted]% RPM [revenue-per-mille] increase, [with] some ad units seeing [a] [redacted]% increase."[626] In 2017, Google estimated that EDA delivered publishers "on average, a [redacted]%+ uplift in yield."[627] An experiment from 2017 found that EDA increased overall publisher revenue by nearly $[redacted] per day.[628]

3. How EDA Increased Efficiency

332. In addition to increasing publishers' revenue, EDA also improved efficiency by ensuring that fewer impressions went unsold and that the impressions allocated to remnant demand were the impressions for which remnant bidders had the highest values. Because EDA assigned to guaranteed contracts the impressions with the lowest bids from remnant demand (including the ones without bids that exceed the relevant floor price, which could not be sold to remnant demand at all), EDA could often reduce the number of unsold impressions, expanding output. Similarly, the total value of impressions allocated to remnant demand increased because the impressions allocated to remnant bidders were the ones for which they had the highest bids, which are also the impressions for which they had the highest values.

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[626] Comms Doc, "Enhanced Dynamic Allocation" (Nov. 6, 2017), GOOG-DOJ-06885161, at -164 (under heading, "First Results").

[627] Presentation, "DoubleClick's Unified Stack - DFP + AdX" (Sep. 20, 2017), GOOG-DOJ-09163089, at -103.

[628] "Enhanced Dynamic Allocation" (Apr. 3, 2017), GOOG-DOJ-13208758, at -759 ("Publisher revenue increase is ~[redacted] / day or approximately [redacted] ARR.").

C. Responding to Plaintiffs' and Their Experts' Allegations

1. Plaintiffs and Their Experts Make Factual Errors in Their Description of EDA

333. The description of EDA by Plaintiffs and their experts contains several significant factual inaccuracies.

a. *First*, Plaintiffs state that EDA was "opening up a new additional pool of publishers' inventory to exactly one exchange: AdX,"[629] with Professor Gans asserting that "[n]o other exchange has this ability."[630] This is wrong. Whenever EDA allowed AdX to compete for an impression, it also allowed any non-guaranteed line items representing non-Google exchanges (and other demand sources) to compete.[631] This means that non-Google demand sources also benefited from EDA, allowing them to win additional impressions. An analysis of data from 2018-2019 found that around [redacted]% of the revenue increase caused by EDA came from remnant line items (rather than from buyers on AdX).[632]

b. *Second*, Plaintiffs assert that "Google's exchange could transact the impression if an advertiser returned a net bid greater than both (a) the price Google set for itself and called the 'EDA reserve price' and (b) the average historical bids belonging

[629] Fourth Amended Complaint ¶ 284.

[630] *See* Expert Report of J. Gans (Jun. 7, 2024), at ¶ 630.

[631] *See* Comms Doc, "Enhanced Dynamic Allocation" (Nov. 6, 2017), GOOG-DOJ-06885161, at -169 ("How does this affect other remnant line items? Remnant line items continue to function according to dynamic allocation rules - if a remnant [Line Item] (say, a network) has a higher eCPM than AdX, it will still get the impression with this optimization turned on.").

[632] Emails from [redacted] to N. Korula, "Re: EDA Performance Remnant v.s. AdX" (Oct. 23, 2019), GOOG-AT-MDL-008935836, at -836 (Tables, column "extra remnant rev / extra total").

to rival exchanges."[633] Any suggestion that Google used EDA to manipulate the auction's reserve price in its own favor is incorrect. As Google told publishers, the EDA price was calculated to maximize publishers' revenues while ensuring the fulfillment of publishers' guaranteed contracts.

c. *Third*, Plaintiffs state that EDA "permitted AdX to transact high-value impressions for one penny more than a price floor that Google set for itself,"[634] but that description ignores the other floor prices set by publishers. EDA added an *additional* floor price, meaning that winning AdX bidders needed to exceed the floor price set by the publisher, in addition to the EDA price and other remnant bids.[635] Moreover, as I have explained in Section III.C.3.a, the fact that the winning bidder pays the larger of the floor price and the highest competing bid is the *defining* feature of the second-price auction format. In the second-price auction, the ability to observe the floor price (or a competitor's bid) offers no advantage to the bidder.

d. *Fourth*, Plaintiffs claim that "Google falsely told publishers that EDA 'maximizes yield.'"[636] However, as I demonstrate in Theorem 2, EDA *did* maximize the revenue from a publisher's demand sources. A lower EDA price would have resulted in a publishers' guaranteed contracts going unfulfilled, and a higher EDA

[633] Fourth Amended Complaint ¶ 289.

[634] Fourth Amended Complaint ¶ 289.

[635] *See* Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 22 ("Between the launch of Enhanced Dynamic Allocation in 2014 and the launch of the Unified First Price Auction in 2019, the floor price in AdX was the highest of: (i) the publisher-configured floor price; (ii) the Enhanced Dynamic Allocation price set dynamically based on a temporary CPM (the 'EDA price'); (iii) the price of the remnant line item that was selected as a candidate for the impression; and (iv) the price determined by optimization.").

[636] Fourth Amended Complaint ¶ 291.

price would have risked lower revenues from the sale of impression. Because the higher of the EDA price and the publisher-set floor applied to an impression, a publisher could set floor prices higher than the EDA price if they found it in their interest to do so.[637]

e. *Finally*, Plaintiffs argue that EDA allowed AdX to "transact publishers' impressions for depressed prices."[638] But by adding an additional floor price to a second-price auction, EDA only *increased* the prices at which publishers' impressions were sold. Moreover, Google's experiments found that EDA led to a significant increase in publisher's revenues from remnant demand, on the order of [redacted]%.[639]

2. EDA Does Not Leave Non-Google Exchanges with Lower Value Inventory

334. Plaintiffs and their experts allege that "EDA allowed AdX to transact a higher proportion of publishers' high-value inventory," resulting in "cherry-picking" or "cream-skimming" in which "more valuable transactions [are] transacted through AdX rather than direct deals."[640] Professor Weinberg adds that "[t]his cream-skimming effect reduces the value

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[637] *See* Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 22 ("Between the launch of Enhanced Dynamic Allocation in 2014 and the launch of the Unified First Price Auction in 2019, the floor price in AdX was the highest of: (i) the publisher-configured floor price; (ii) the Enhanced Dynamic Allocation price set dynamically based on a temporary CPM (the 'EDA price'); (iii) the price of the remnant line item that was selected as a candidate for the impression; and (iv) the price determined by optimization.").

[638] Fourth Amended Complaint ¶ 289 ("Moreover, EDA hurt publishers' yield by permitting AdX to transact publishers' impressions for depressed prices. DFP permitted AdX to transact high-value impressions for one penny more than a price floor that Google set for itself—despite Google's obvious conflicts of interest. Google's exchange could transact the impression if an advertiser returned a net bid greater than both (a) the price Google set for itself and called the 'EDA reserve price' and (b) the average historical bids belonging to rival exchanges.").

[639] Comms Doc, "Enhanced Dynamic Allocation" (Nov. 6, 2017), GOOG-DOJ-06885161, at -164 (under heading, "First Results"); Presentation, "DoubleClick's Unified Stack - DFP + AdX" (Sep. 20, 2017), GOOG-DOJ-09163089, at -103.

[640] Expert Report of P. Pathak (Jun. 7, 2024), at ¶ 172 ("EDA allowed AdX to transact a higher proportion of publishers' high-value inventory by being able to bid for impressions previously reserved for direct deals."). *See*

of direct deals with publishers in the long run [and] potentially leads to a negative impact on the publisher revenue in the long run."[641]

335. To investigate the claim that EDA resulted in guaranteed contracts receiving "lower value" impressions, I performed an empirical analysis of Google data, using industry-standard quality measures to compare the quality of the impressions that EDA allocated to guaranteed contracts to the quality of all impressions that satisfied the contract terms.[642] The data I analyzed were from a time in which many non-Google exchanges participated in header bidding (see Section X) and/or Open Bidding (see Section XIII) and thus used real-time bids, allowing them to bid more for higher-quality impressions.

336. For the quality of each impression, the industry-standard measures that I use are **predicted engagement metrics**. When there are several guaranteed contracts eligible for an impression, Google uses these to decide which one to serve to maximize predicted engagement, that is, Google's estimate of the fraction of impressions for which a user

also Fourth Amended Complaint ¶ 292 ("Google understood that EDA was a scheme to let its own AdX exchange simply 'cherry-pick [publishers'] higher-revenue impressions.'"). *See also* Expert Report of M. Weinberg (Jun. 7, 2024), from ¶ 142 to ¶ 144 ("If impressions that satisfy targeting criteria for direct deals are on average more valuable than impressions that do not, then Enhanced Dynamic Allocation results in more valuable transactions being transacted through AdX rather than direct deals. Therefore, Enhanced Dynamic Allocation would not only lead to increased volume and revenues for AdX, but also to a greater volume of valuable impressions being transacted through AdX[…]. This cream-skimming effect reduces the value of direct deals with publishers in the long run from the perspective of the advertisers.").

[641] *See* Expert Report of M. Weinberg (Jun. 7, 2024), from ¶ 142 to ¶ 144 ("If impressions that satisfy targeting criteria for direct deals are on average more valuable than impressions that do not, then Enhanced Dynamic Allocation results in more valuable transactions being transacted through AdX rather than direct deals. Therefore, Enhanced Dynamic Allocation would not only lead to increased volume and revenues for AdX, but also to a greater volume of valuable impressions being transacted through AdX[…]. This cream-skimming effect reduces the value of direct deals with publishers in the long run from the perspective of the advertisers.").

[642] The Google metrics I use below comply with industry standards for measuring clicks, views, and active views. *See* Media Rating Council, Minimum Standards for Media Rating Research, Media Rating Council (accessed Sep. 29, 2023), https://mediaratingcouncil.org/standards-and-guidelines.

engages with a particular ad. These metrics are the **predicted Click-Through Rate (pCTR)**,[643] **predicted View-Through Rate (pVTR)**,[644] and **predicted Active View Rate (pAVR)**.[645]

i) Data

337. I received a week of data, from October 30th to November 5th, 2022 corresponding to over [redacted] different guaranteed contracts.[646] The included contracts are all the ones that, on any day, (1) won and served at least 100 impressions under EDA and (2) for at least one of the three predicted-engagement statistics, lost at least 100 impressions under EDA.[647]

338. For each guaranteed contract, the dataset includes the numbers of impressions won and lost by the guaranteed contract and the predicted engagement metrics—pCTR, pVTR and pAVR—as described above. For each guaranteed contract and each engagement metric, I have access to:

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[643] *See* Google, "Ad Manager report metrics," Google Ad Manager Help (accessed Sep. 29, 2023), https://support.google.com/admanager/table/7568664?hl=en ("Ad Exchange CTR[:] The percentage of impressions served by the Ad Exchange that resulted in users clicking on an ad.").

[644] *See* Google, "Understand Video Solutions report metrics," Google Ad Manager Help (accessed Jul. 24, 2024), https://support.google.com/admanager/answer/2759433#video-viewership ("View-through rate[:] Percentage of times the ad was viewed.").

[645] *See* Google, "How Active View metrics are calculated," Google Ad Manager Help (accessed Sep. 29, 2023), https://support.google.com/admanager/answer/6233478?hl=en&ref_topic=7506202 ("Active View metrics are calculated by finding the percentage of total impressions served that are actually viewable impressions").

[646] EDA pCTR Dataset, GOOG-AT-DOJ-DATA-000066771 to -772. The number of guaranteed contracts was calculated in the file code/pctr.py of my supporting materials. The output is logged to code/logs/pctr.txt.

[647] *See* Letter from D. Pearl to M. Freeman (Sep. 8, 2023), GOOG-AT-MDL-C-000012795, at -802 to -803 (describing the EDA pCTR dataset). For some contracts or impressions, Google does not compute any engagement metrics. Those impressions are not included in the dataset.

a. **Field #1:** The average value of the predicted-engagement metric over all impressions that would be eligible to fulfill the guaranteed contract.

b. **Field #2:** The average value of the predicted-engagement metric over the impressions allocated to the guaranteed contract.

ii) Methodology

339. I treat Field #1 as a measure of impression quality in a counterfactual "without EDA" scenario. I expect Field #1 (which contains the average value of the predicted-engagement metric over all eligible impressions) to be equal to the average value of that metric over impressions assigned to guaranteed contracts without EDA. The reason is that, before EDA, the impressions assigned to guaranteed contracts were the first eligible impressions to arrive in the relevant time period and, in terms of ad quality, I have no reason to believe that those impressions differ systematically from an average impression. Field #2 contains a measure of the quality of impressions that were allocated to guaranteed contracts in the actual world "with EDA." I compare values in the two fields to assess how EDA affected the quality delivered to guaranteed contracts. If adverse selection were an economically significant factor, the average measure of quality "without EDA" (Field #1) would be significantly larger than the average measure of quality "with EDA" (Field #2).

iii) Main Finding: Differences in Predicted-Engagement Metrics are Less than [redacted]%

340. I first computed the average predicted engagement metrics with and without EDA across all guaranteed contracts. I display my findings in Table 5.

Table 5: Change in Engagement Metric With EDA[648]

[redacted]

341. The main findings are:

a. *The* **predicted click through rates (pCTR)** *with and without EDA are nearly the same*. In terms of numbers of clicks, Google predicts [redacted] clicks per 100,000 impressions without EDA and [redacted] clicks with EDA. This means that the number of expected clicks for guaranteed contracts with EDA is about [redacted]% less than without EDA.

b. *The* **predicted view through rates (pVTR)** *with and without EDA are nearly the same.* Impressions allocated to guaranteed contracts via EDA have an approximately [redacted]% higher average pVTR, which means that the number of view-throughs for guaranteed contracts is about [redacted]% more than before EDA.

c. *The* **predicted active view rates (pAVR)** *with and without EDA are nearly the same.* The impressions won by guaranteed contracts under EDA have an approximately [redacted]% lower pAVR, which means that the number of active views for guaranteed contracts is about [redacted]% less than before EDA.

[648] These results were calculated in the file code/pctr.py of my supporting materials. The outputs are logged to code/logs/pctr.txt.

342. If the effects of "cream-skimming" were economically significant, one would expect the predicted engagement metrics on impressions allocated to guaranteed contracts to be substantially lower than the same metrics on the set of all eligible impressions. But they are not. Instead, the data shows decreases in just two of the three predicted engagement metrics, with all differences just [redacted].

iv) Publisher-Level Heterogeneity

343. The preceding results are average engagement rates over all publishers and guaranteed contracts. Averaging at this level still leaves open the possibility that some publishers could have suffered a significant loss. To evaluate that possibility, I conducted a similar analysis at the publisher level. I present my findings using a scatterplot in which each point represents a different publisher. On the two axes of the plot are the publisher's engagement metric in the EDA data vs. the same metric in the hypothetical pre-EDA scenario. Figure 12 shows the publisher-level scatterplot for pCTR.[649] If publishers experienced no selection effects, all points would lie exactly on the 45° line (the black dashed line in Figure 12), indicating that the publisher's pCTR is just the same with or without EDA. Points below the line correspond to publishers with worse pCTR impressions with EDA than without EDA ("adverse selection"), while the points above the line correspond to publishers with better impressions with EDA than without it ("positive selection"). The left panel shows the data for all publishers. The right panel is a zoomed-in version, focused at the range below 0.5% pCTR, where most observations lie. The colors of each point encode the logarithm of the number of impressions allocated to

[649] Figure 12 was generated by running the file code/pctr.py in my supporting materials. The figure is located at code/figures/pctr_regression.png.

guaranteed contracts in the data. I have also plotted (in red) the line of best fit to those points, using a weighted least-squares regression with zero intercept and with the number of winning impressions as weights.

Figure 12: Scatterplot of pCTR by publisher with/without EDA

344. Visually, the line of best fit (in red) and the 45° line (the dashed black line) are nearly indistinguishable, suggesting that EDA had a negligible effect on predicted engagement rates, uniformly across publishers. To express the same finding with a statistic, I calculate the slope coefficient of the best-fit line (the regression coefficient). If there was no difference in the predicted engagement rates with and without EDA, the regression coefficient would be 1.000. The computed regression coefficient is [redacted], suggesting that any difference in quality caused by EDA is very small indeed.

345. The computed regression coefficients for pAVR and pVTR are also suggestive of minor quality differences, with values of [redacted] and [redacted], respectively. The corresponding figures for those predicted engagement metrics can be found in Section XV.C.3 of the Technical Notes.

v) My Empirical Analysis Undermines Plaintiffs' Experts Conclusions About "High-Value" Ads

346. Together, these findings refute the idea that EDA systematically allocates "low-value" impressions to guaranteed contracts in the way that Plaintiffs and their experts suggest. On the contrary, there is barely any detectable quality difference between the impressions those contracts win or lose. The absence of a material, observed difference in quality in this data suggests that, on the dimensions of impression quality that Google uses for its own purposes, there is no economically important "cream-skimming." Moreover, since remnant bidders (including header bidders and exchanges in the waterfall) can condition their payments on more information than guaranteed contracts, it is reasonable to expect that, in all or most cases, non-Google bidders suffer even *less* harm than guaranteed contracts from any hypothetical "cream-skimming" by Google's ad-allocation processes, including DA and EDA.[650]

347. Instead of relying on data, Professor Weinberg forms his opinion on the basis of a hypothetical example, concluding that EDA reduces the quality of impressions served to guaranteed contracts and "*potentially* leads to a negative impact on the publisher revenue in the long run."[651] His example considers an "impression [] for a user over the age of 25 who likes running, [...] has recently visited several shoe-shopping websites, lives in a

[650] If "cream-skimming" was a significant factor in any part of the Google ad allocation process, then the residual impressions EDA allocates to guaranteed contracts should be of lower quality than the impressions allocated to either AdX or non-Google exchanges because these residual impressions attracted low bids—below the EDA price—not just by AdX bidders but also by competing exchanges.

[651] Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 144 (emphasis added) ("This cream-skimming effect reduces the value of direct deals with publishers in the long run from the perspective of the advertisers. Hence, it potentially leads to a negative impact on the publisher revenue in the long run.").

wealthy neighborhood, and competes in races."[652] The impression "satisfies the targeting criteria for a direct deal with Altra, with a Value CPM of $10," but loses an auction to another advertiser (Reebok) bidding through AdX.[653] This is intended to show that EDA allows AdX bidders to "cream-skim" impressions that would be of equal or more value to guaranteed contracts.[654] However, Professor Weinberg's example is unrepresentative, as it oversimplifies the diversity of advertiser and end user interests.

348. End users are typically potential buyers for many different products on the web. For instance, the user in Professor Weinberg's example who likes running and races likely has other interests, too. Perhaps he may be planning a vacation or a move into a new home. Because users buy a variety of products, the same users are often targeted by advertisers from many industries, with advertisers differing in their values for each particular impression. In Professor Weinberg's words, "bidders are heterogeneous in their valuation for impressions."[655] By allowing a diverse pool of advertisers to compete for each user's attention, EDA leverages that bidder heterogeneity and facilitates matches that can be significantly better than when *only* the guaranteed advertiser can serve the impression. In

[652] Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 135 ("Another impression arrives for a user over the age of 25 who likes running, and with further fine-grained cookies noting that the user has recently visited several shoe-shopping websites, lives in a wealthy neighborhood, and competes in races.").

[653] Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 135 ("The highest bidder that exceeds their personalized reserve is Nike for $8 through OpenX, and this is entered as a line item in DFP, which then begins the waterfall, and notices that this satisfies the targeting criteria for a direct deal with Altra, with a Value CPM of $10, which is the highest Value CPM among all line items. DFP then calls AdX with a reserve of $10, whose auction concludes with Reebok winning at a clearing price of $15. Reebok wins the impression through AdX, paying $15. This example is illustrated in Figure 27 below.").

[654] *See* Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 136 ("The last example also highlights one reason that AdX might possibly outbid high priority line items which typically have a much higher CPM compared to remnant line items, that the fine-grained targeting criteria may alert live demand sources of a particularly high value impression and bid higher than the direct deal price that is typically based on coarser targeting criteria.").

[655] *See* Expert Report of M. Weinberg (Jun. 7, 2024), at ft. 62 ("[B]idders are heterogeneous in their valuation for impressions (the impression from an avid runner is valued differently by Nike and McDonald's)[.]").

contrast to Professor Weinberg's example, when EDA allocates an impression to remnant demand instead of Altra's direct contract, that often happens because the user is targeted by an advertisement for a product *other than running shoes*. EDA can promote better matching by allocating the ad slot to Altra or Reebok when the user is researching running shoes, to American Airlines when he'd like to fly, or to a furniture seller during a move. The resulting matching tends to improve the experience for end users, increase revenues for publishers, and is also likely to increase the surplus of advertisers.

349. Furthermore, Professor Weinberg's example omits discussion of Altra's overall display advertising strategy, which might include a combination of guaranteed and programmatic advertising. In that case, EDA would make it *easier* for Altra to win valuable remnant inventory (including the remarketing impression described in Professor Weinberg's example) using real-time bidding. When Altra adopts this combination, it can effectively capture the attention of end users who have "visited several shoe-shopping websites" and also reach users who might not have been familiar with Altra. As a result, EDA can increase the value of impressions won by Altra on average across direct deals and remnant campaigns.

350. Professor Weinberg claims that, as a result of cream-skimming, EDA "reduces the value of direct deals with publishers in the long run[…] ***potentially*** lead[ing] to a negative impact on[…] publisher revenue in the long run."[656] However, Professor Weinberg's argument provides no actual evidence that EDA reduced the value of direct deal advertising or that publisher revenues were reduced. My analysis of the

[656] *See* Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 144 (emphasis added) ("This cream-skimming effect reduces the value of direct deals with publishers in the long run from the perspective of the advertisers. Hence, it potentially leads to a negative impact on the publisher revenue in the long run.").

predicted-engagement data shows that, to the contrary, EDA did not reduce the value of direct deal advertising. But even if it were true that EDA "reduce[d] the value of direct deals,"[657] Professor Weinberg provides no justification for why any decrease in guaranteed contract revenue would outweigh the potentially significant increases in revenue from remnant demand sources. Indeed, if EDA increased the average revenue per impression allocated to remnant advertising, that would increase the competition for all impressions and contribute to an increase in the price of direct deals as well, which is the opposite of what Professor Weinberg's analysis implies.

351. Professor Pathak claims that "Google reduced publisher choice when it restricted publishers' ability to opt out of Enhanced Dynamic Allocation" and that "EDA diminished publishers' control […] for their high-value inventory."[658] But, as I have shown, EDA *maximizes* publisher revenues, while having no economically significant effect on the quality of impressions allocated to guaranteed contracts. Because EDA *increased* ad server functionality by unifying the competition between guaranteed and remnant demand, publishers had no incentive to "opt out."

[657] *See* Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 144.

[658] Expert Report of P. Pathak (Jun. 7, 2024), at ¶¶ 172 ("Google reduced publisher choice when it restricted publishers' ability to opt out of Enhanced Dynamic Allocation (or 'EDA') while using Google's advertising exchange AdX."), 173 ("EDA diminished publishers' control over demand sources for their high-value inventory. EDA allowed AdX to transact a higher proportion of publishers' high-value inventory by being able to bid for impressions previously reserved for direct deals. Publishers did not have the option to selectively turn off EDA for a selection of their premium inventory available through direct deals, and instead had to allow AdX the ability to bid for all of their premium inventory. Google therefore diminished publishers' ability to be selective with demand sources and publishers had to allow for the possibility of AdX serving lower-quality ad impressions for their most premium inventory.").

X. HEADER BIDDING AND THE DUBIOUS "LAST LOOK ADVANTAGE"

A. Overview

352. Header bidding is a technology that allows publishers to solicit and compare real-time bids from their selected sets of exchanges and other demand sources.[659] Typically, header bidding used a first-price auction to compare bids from the publisher's chosen demand partners.[660] If a publisher configured its website to run header bidding before offering an impression to AdX, AdX would obtain a so-called "**last look**" at each impression. The so-called "last look" was not a Google program, but arose as a consequence of the way that some publishers configured header bidding.[661] Those publishers benefited from offering AdX bidders the chance to bid on inventory (rather than using header bidding alone) because the additional competition for each impression allowed them to earn higher revenues and because it allowed them to enjoy the benefits of the services that GAM provided on each impression.

353. AdX was not the only exchange that collected bids after header bidding auctions had been resolved: other exchanges with ad servers, such as OpenX, treated header bids

[659] Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 13 ("When a user visits the publisher's site, the browser calls participating ad exchanges or other demand partners (either directly or via a header bidding server) to submit bids, and runs an auction between those bids before Google's ad server is called.").

[660] Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 13 ("These Header Bidding auctions are typically first-price auctions.").

[661] Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 17 ("'[L]ast look' was not designed to give AdX an advantage when competing against Header Bidding. It was simply the result of the Header Bidding auction taking place before the AdX auction ran and the way that publishers configured Header Bidding line items to work with Dynamic Allocation.").

similarly.[662] As I discuss in Section XIV, when AdX transitioned to the Unified First Price Auction in 2019, AdX bidders and remnant line items (including those representing header bidding) competed simultaneously, eliminating any claimed "last look."

354. Plaintiffs allege that the so-called "last look" gave AdX an advantage over third-party exchanges because it "let AdX peek at the winning net bid from an exchange using header bidding, then displace the trade by paying one penny more."[663] However, these allegations are based on flawed analyses that systematically ignore how incentives affect bidder and publisher behavior.

a. *Bidder incentives*. While Plaintiffs analogize "last look" to "insider trading" and "front running"[664] and their experts claim that it "creates information asymmetries,"[665] the ability to see competing bids in a second-price auction (such

[662] OpenX, "Selling Rules" (Dec. 12, 2016), https://web.archive.org/web/20170708051049/https://docs.openx.com/Content/publishers/userguide_inventory_realtimeselling.html ("If the selected line item is for non-guaranteed delivery, before serving the ad for the selected line item, OpenX will give buyers in the real-time bidding exchange the opportunity to bid on the ad space. If a bid is higher than the selected line item, and it matches or exceeds the floor price set for the selling rule, then OpenX serves the ad of the winning bidder, rather than the ad for the line item originally selected by the ad server.").

[663] *See* Fourth Amended Complaint ¶ 377 ("From the earliest days of header bidding, DFP let AdX peek at the winning net bid from an exchange using header bidding, then displace the trade by paying one penny more. Industry participants called this practice, along with Dynamic Allocation, Google's 'Last Look.' Other industries call analogous conduct by intermediaries 'insider trading' and 'front running.' According to a confidential Google study evaluating the effects on competition, Last Look significantly re-routed trading from non-Google exchanges to AdX and Google's ad buying tools, protecting Google's market power in both. Google itself admitted: 'Last Look is inherently unfair.'").

[664] *See* Fourth Amended Complaint ¶ 377 ("Other industries call analogous conduct by intermediaries 'insider trading' and 'front running.'").

[665] *See* Expert Report of J. Gans (Jun. 7, 2024), at ¶ 594 ("Notably, after the introduction of Header Bidding, DFP could pass the winning Header Bidding bid to AdX as the price floor in its real-time auction. This advantage became known as 'Last Look', where AdX 'gets to bid with knowledge of the clearing price.'"). *See also* Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 119 ("Hence, Dynamic Allocation allows AdX (and only AdX) to learn others' bids in a first-price auction format, and as a result, Dynamic Allocation creates information asymmetries that favor Google's AdX. This advantage is often referred to as AdX's Last Look advantage."). *See also* Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 126 ("[U]nder Dynamic Allocation, AdX is the only exchange that learns information about others' bids and passes it on to its bidders[...] I previously noted that this is referred to as AdX's Last Look advantage and constitutes a significant advantage in an auction[...].").

as the one AdX used before 2019) does not confer an advantage to the bidder.[666] Indeed, bidders in a second-price auction are incentivized to bid their values regardless of competing bids or the floor price (as described in Section III.C.3.a). Sometimes a winning bid results in trade at the floor price, but—in those cases—*no* alternative bid would lead to a higher price for the publisher. Moreover, Google's own demand sources, Google Ads and DV360, never used bids from header bidding (or the value CPMs of header bidding line items) to adjust the amount they bid on the same impression.[667]

b. *Publisher incentives*. Publishers could maximize their revenues by inflating the header bids that they submit to AdX (that is, triggering a line item with a *higher* value CPM than the winning header bid), leading to higher floor prices on AdX.[668] Configuring header bidding this way would require a bidder on AdX to bid *more than* a penny above the highest bid made in header bidding in order to win. These higher floor prices reduce or eliminate any advantage that might arise as a result of header bidding being conducted in first-price format (in which bidders optimally bid less than their values, as described in Section III.C.3.b) whereas the AdX auction was conducted in second-price format. In practice, internal Google documents suggest that many publishers, in line with these economic incentives,

[666] Note that bidders on AdX (and AdX itself) did not observe header bids directly (see Paragraph 357).

[667] Declaration of N. Jayaram (May 1, 2024), GOOG-AT-MDL-C-000017969, at ¶ 3 ("Before Google Ad Manager transitioned to a Unified First-Price Auction in 2019, Google Ads and DV360 never used a floor price in an auction for an ad impression to adjust the bid values that they would submit for that same ad impression.").

[668] Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 11 ("Some publishers set Value CPMs higher than their estimates of what CPM a line item would likely generate to increase competitive pressure in the AdX auction or for other reasons.").

configured header bidding to trigger line items that set the AdX second-price auction floor *greater* than the highest header bid.[669]

355. Since 2014, Google's ad server has limited the maximum number of active line items to 61,000[670] in order "to protect the health of the product [and] the performance of [Google's] system."[671] Because some publishers implemented header bidding in GAM using many thousands of line items, Plaintiffs assert that this "throttles publishers' use of header bidding by artificially capping publishers [*sic*] use of 'line items' [...]."[672] However, my analysis of GAM data in Section X.D.4 below finds that publishers rarely approach the 61,000 threshold in practice. Although Professor Gans opines that "Google's motive in imposing limits to the number of line items… was to restrict

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[669] *See* Product Requirements Doc, "PRD: Unified 1P auction and Pricing rules" (Jul. 25, 2018), GOOG-DOJ-03998505, at -506 ("[Some publishers] inflate the value CPM of remnant line items [...] publishers used to do this even before HB was popular."); Presentation, "First-price bidding" (Aug. 12, 2019), GOOG-DOJ-11406673, at -677 ("How boost works[:] The publisher inflates the HB bid before sending it as a floor to AdX[.] This is done to increase Adwords cost and to provide a better comparison between Adwords and header bidder bids[.]"). *See also* Email from [redacted] to [redacted] et al., "Unified Auction Changes (Sellside) Executive Update - Aug 12, 2019" (Aug. 13, 2019), GOOG-DOJ-09713317, at -319 ("Today, these [publisher-]inflated CPMs are used to provide price pressure for AdX [...] In practice, [...] many publishers [...] apply a boost to Header Bidding bids[.]"); Presentation, "Changes to Ad Manager, AdMob auction" (Sep. 3, 2019), GOOG-DOJ-14549757, at -777 ("Last look [...] incentivizes pubs to inflate ('boost') the floor sent to AdX"); [redacted]

[670] Comms Doc, "Limits Enforcement" (Feb. 16, 2018), GOOG-DOJ-09494195, at -198 ("Number of active line item limits (please note: Each creative-level targeting criterion counts also toward the active line item limit[:] 61,000").

[671] Comms Doc, "Limits Enforcement" (Feb. 16, 2018), GOOG-DOJ-09494195, at -195 ("In 2014, we have started enforcing limits on the creation of certain entities in the DFP Ul, e.g. Lls per order, Creatives per LI, Ad units for placements and Targeting attributes in line items. [...] Limits are necessary in order to protect the health of the product, the performance of our system, and are ultimately for the benefit of all publishers and the performance of their Ul (unlimited number of entities can affect the Ul in terms of load time and serving in some cases). NOTE: Our limits are much higher than those that existed previously in DART.").

[672] Fourth Amended Complaint ¶ 389.

competition in the ad exchange market" and dismisses Google's reasons for the limits as "pretextual,"[673] the documents he relies upon undermine his opinion and suggest that Google had legitimate technical reasons to protect its systems from the strain caused by publisher configurations with unusually many line items.

B. How the So-Called "Last Look" Arose As a Consequence of Some Publishers' Configuration of Header Bidding in GAM

356. **Header bidding** is a technology that allows publishers to request and compare real-time bids from multiple demand sources simultaneously.[674] It began to gain popularity around 2014,[675] years after Dynamic Allocation launched, as a way for publishers to incorporate real-time bids from multiple exchanges.[676] Publishers typically implemented header bidding through snippets of code (in the header of the web page) that sent bid requests from the end user's browser to ad exchanges.[677] Header bidding can be described as an

[673] *See* Expert Report of J. Gans (Jun. 7, 2024), at ¶ 646 ("Google's motive in imposing limits to the number of line items available to publishers, and denying requests for those limits to be raised, was to restrict competition in the ad exchange market by making Header Bidding more difficult and costly to the largest and most important publishers. While Google offered various technical explanations for the caps, these were pretextual.").

[674] Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 13 ("When a user visits the publisher's site, the browser calls participating ad exchanges or other demand partners (either directly or via a header bidding server) to submit bids, and runs an auction between those bids before Google's ad server is called.").

[675] Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 13 ("Around 2014, web publishers began to adopt Header Bidding."). *See also* AdPushup, "Header Bidding" (2023), https://www.adpushup.com/header-bidding-guide/ ("Header bidding made it to ad tech somewhere around 2014. And only after one year, in 2015, the technique went viral.").

[676] An internal document describes header bidding as a process motivated by publishers "clamouring" for "per-query bid" functionality from other exchanges, see Presentation, "Demand Syndication" (Feb. 17, 2016), GOOG-DOJ-09459336, at -337 ("Turns out that getting per-query bids from exchanges dramatically increases yield (auctions more efficient), so pubs are clamouring for this functionality") (emphasis omitted).

[677] My understanding of the configuration of header bidding in DFP is based on Presentation, "Demand Syndication" (Feb. 17, 2016), GOOG-DOJ-09459336, at -338 to -339.

auction of auctions because demand sources would typically determine their bids using an internal auction before participating in the header bidding first-price auction.[678]

357. As described in Section III.D.3.f, header bidding could directly allocate the impression to the highest bidding exchange,[679] but, for the reasons I discuss in Section X.C below, many publishers sought to integrate header bidding with Google's ad server.[680] Because line items in DFP were not designed to accept real-time bids from non-Google exchanges,[681] these publishers used non-guaranteed line items—originally intended to represent static bids from ad networks—to instead represent real-time bids from non-Google exchanges.[682] To accomplish that, a publisher would configure its header bidding code to select a non-guaranteed line item with an accompanying value CPM in Google's ad server. These value CPMs could be chosen freely by the publisher and, importantly, could differ from the winning header bid. Prebid.js, one of the leading header bidding tools,

[678] *See* Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 13 ("These Header Bidding auctions are typically first-price auctions."). *See also* Prebid.org, "Prebid.js FAQ" (accessed Dec. 1, 2023), https://docs.prebid.org/dev-docs/faq.html ("Header Bidding is a first-price auction").

[679] *See* Prebid.org, "Running Prebid.js without an ad server" (accessed Sep. 7, 2023), https://docs.prebid.org/dev-docs/examples/no-adserver.html ("This example demonstrates running [a header bidding] auction and rendering without an ad server.").

[680] *See* Presentation, "Header Bidding Observatory #1" (Jan. 2017), GOOG-DOJ-AT-01027937, at -939 ("43% of LPS publishers are using header tags").

[681] Deposition of [redacted] at 71:18-21 (Aug. 12, 2021), GOOG-AT-MDL-007178292, at -363 ("So in the original design of the system, it was not designed to put exchanges in as line items. Line items are designed to represent direct deals or network deals."); Deposition of [redacted] at 50:8-20 (Nov. 6, 2020), GOOG-AT-MDL-007172126, at -176 ("The way the system was built is that line items were always intended to be reservations. There wasn't a concept of using them for realtime pricing. And so we had in mind that publishers would have, you know, possibly thousands of line items and the system was built to scale to that, but with using line items for realtime pricing, which is not what they were designed to be used for, there were ten, sometimes ten times, sometimes 100 times, sometimes 1,000 times more line items than the system was designed to support.").

[682] Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 14 ("Up until at least December 2021, the winning bid from the Header Bidding auction was typically used to trigger a specific line item that the publisher had booked within Google's ad server (most commonly a remnant line item), and […] the Value CPM of that line item could represent the winning Header Bidding bid as a floor in the AdX auction (prior to September 2019) or as a competing bid in the Unified First Price Auction (from September 2019 onwards).").

contains an inbuilt feature to adjust header bids before they are sent to the ad server, with Pubstack, a supply-side tool, detailing how the feature could be used to "giv[e] Prebid an edge in the competition against GAM" by inflating header bids.[683] The actual header bids are never observed by GAM or bidders on AdX. GAM would use the value CPM of the header bidding line item in its ad selection process (including DA and EDA). As a result, the highest bid from an AdX bidder would win the impression only if it exceeded the highest value CPM associated with header bidding line items and any other floor prices that might apply to the impression. If there was no such higher AdX bid and the header bidding line item had the highest value CPM among all the other line items, the impression would be allocated to the winning header bidder.

358. In each auction, AdX bidders are informed of the highest floor price applying to that impression.[684] Because a header bidding line item sometimes determines the auction's floor price, critics have sometimes described AdX as having had a "last look" over header bids.[685] However, as just described and in further detail in Section X.D.1 below, the resulting floor price need not be *equal to* the winning header bid. In fact, publishers had an incentive to, and often did, set the floor price *higher than* the winning header bid,

[683] Asmaâ Bentahar, "Bid Adjustments Simplified: Run Fair Auctions with no Hassle," Pubstack (May 2, 2021), https://www.pubstack.io/topics/bid-adjustments-simplified ("Alternatively, this next one will slightly increase all returned CPMs, giving Prebid an edge in the competition against GAM").

[684] Before 2016, Authorized Buyers (then "AdX buyers") could only see the highest floor price among the "rule" floor prices set by the publisher and any floor price determined by RPO, but since 2016, all bidders see the highest among all the floor prices, including those determined by the value CPMs of remnant line items. *See* Launch Doc, "Including Third-Party Threshold in the Revealed Reserve Prices to AdX Buyers" (Aug. 9, 2016), GOOG-DOJ-13208800, at -800 ("We propose to include third-party threshold in the revealed reserve prices sent to AdX buyers, in support to AdX dynamic revshare v2 launches. Currently we reveal the maximum of rule prices and RPO prices in the RTB as well as JEDI callouts and in the internal RPC to GDN / DBM. With this change we will reveal the maximum of rule prices, RPO prices, as well as third-party threshold (e.g., EDA prices, competing DFP line item prices).").

[685] Presentation, "Changes to Ad Manager auction" (Jan. 10, 2019), GOOG-DOJ-10924270, at -273 ("AdX and EB have visibility into remnant price before they submit bids (commonly referred to in market as 'last look')").

which might allow the header bid to win even when the AdX bid was higher. By setting floor prices in this manner, a bidder on AdX would need to bid *more than* a penny above the highest bid from a header bidding exchange in order to win the impression.

359. The so-called "last look" was not a Google program: it arose as a consequence of the way that publishers configured header bidding using the line item capabilities that publisher ad servers (including DFP) supported at the time header bidding was introduced.[686] A system that incorporated non-Google exchanges reporting real-time bids directly to GAM required a major redesign, which Google later initiated with the implementation of Open Bidding and completed with the Unified First Price Auction, which I discuss further in Section XIII. Publishers using ad servers besides DFP employed similar techniques to integrate header bidding. Documentation from OpenX—another company that operated both an ad server[687] and an ad exchange—indicates that publishers using their ad server and exchange integrated header bidding in a similar way to publishers using GAM: OpenX bidders competed *after* third-party remnant demand, with header bids

[686] Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 17 ("'[L]ast look' was not designed to give AdX an advantage when competing against Header Bidding. It was simply the result of the Header Bidding auction taking place before the AdX auction ran and the way that publishers configured Header Bidding line items to work with Dynamic Allocation.").

[687] OpenX shut down its ad server after 2018. *See* Sarah Sluis, "OpenX Lays Off 100 Employees And Pivots To Video," AdExchanger (Dec. 18, 2018), https://www.adexchanger.com/platforms/openx-lays-off-100-employees-and-pivots-to-video/.

determining floor prices.[688] [redacted].[689]

C. Publishers Benefited from the So-Called "Last Look"

360. Publishers could use header bidding to sell online display advertising impressions without ever calling GAM or another publisher ad server.[690] But offering AdX bidders a chance to bid on inventory provided two important benefits for publishers.

361. *First*, by allowing competition from an additional source of demand, publishers could increase their revenues on each impression. As long as publishers triggered a header bidding line item with a value CPM at least as large as the best header bid (which they had a clear incentive to do), GAM's ad selection process could increase revenue from the impression, but could never reduce it.

362. *Second*, by offering AdX bidders the chance to bid on an impression, publishers could take advantage of the other services provided by GAM. For example, a publisher that used GAM to manage guaranteed contracts could combine the benefits of header bidding and EDA: a publisher could run header bidding on an impression before calling GAM,

[688] OpenX treated header bids as non-guaranteed line items, *see* OpenX, "Selling Rules" (Dec. 12, 2016), https://web.archive.org/web/20170708051049/https://docs.openx.com/Content/publishers/userguide_inventory_realtimeselling.html ("If enabled, you can designate inventory to sell through OpenX Ad Exchange using selling rules […] When OpenX receives an ad request for inventory defined by a selling rule, it proceeds with the selection process and selects an eligible line item for the ad space. If the selected line item is for non-guaranteed delivery, before serving the ad for the selected line item, OpenX will give buyers in the real-time bidding exchange the opportunity to bid on the ad space. If a bid is higher than the selected line item, and it matches or exceeds the floor price set for the selling rule, then OpenX serves the ad of the winning bidder, rather than the ad for the line item originally selected by the ad server.").

[689] [redacted]

[690] Prebid.org, "Running Prebid.js without an ad server" (accessed Sep. 7, 2023), https://docs.prebid.org/dev-docs/examples/no-adserver.html ("This example demonstrates running [a header bidding] auction and rendering without an ad server.").

and EDA could allocate the impression to the guaranteed contract or the header bid (or another line item), depending on which was expected to maximize publisher revenues.

D. Responding to Plaintiffs' and Their Experts' Allegations

1. Plaintiffs and Their Experts Mistakenly Claim that AdX Buyers Benefit from Additional Information Provided by the So-Called Last Look

363. Plaintiffs allege that the so-called "last look" gave AdX's bidders the ability to "peek" at header bids, analogizing Google's alleged conduct to "insider trading" or "front running."[691] Plaintiffs' experts seemingly agree, with Professor Gans characterizing the so-called "last look" as an "advantage" because AdX "gets to bid with knowledge of the [Header Bidding] clearing price,"[692] and Professor Weinberg arguing that "Dynamic Allocation allows AdX (and only AdX) to learn others' bids in a first-price auction format, and as a result, Dynamic Allocation creates information asymmetries that favor Google's AdX. This advantage is often referred to as AdX's *Last Look advantage*."[693] These allegations are completely wrong.

364. AdX ran a *second-price* auction at the time that DA was launched. As I have explained in Section III.C.3.a, observing others' bids does not advantage bidders in a second-price

[691] *See* Fourth Amended Complaint ¶ 377 ("From the earliest days of header bidding, DFP let AdX peek at the winning net bid from an exchange using header bidding, then displace the trade by paying one penny more. Industry participants called this practice, along with Dynamic Allocation, Google's 'Last Look.' Other industries call analogous conduct by intermediaries 'insider trading' and 'front running.' According to a confidential Google study evaluating the effects on competition, Last Look significantly re-routed trading from non-Google exchanges to AdX and Google's ad buying tools, protecting Google's market power in both. Google itself admitted: 'Last Look is inherently unfair.'").

[692] *See* Expert Report of J. Gans (Jun. 7, 2024), at ¶ 594.

[693] *See* Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 119. *See also* Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 126 ("[U]nder Dynamic Allocation, AdX is the only exchange that learns information about others' bids and passes it on to its bidders[...] I previously noted that this is referred to as AdX's Last Look advantage and constitutes a significant advantage in an auction.").

auction. The reason is that a surplus-maximizing bidder in a second-price auction bids *without regard to the floor price and the bids of other bidders*. The bidding programs used by Google's own demand sources in the AdX second-price auction conform to this theoretical prediction: none adjusted bids depending on the floor price of the auction.[694] If bids do not change in response to floor prices, the ability to see floor prices cannot harm publishers' revenues or benefit AdX bidders.

2. Plaintiffs and their Experts Neglect Publishers' Ability and Incentive to Inflate the Winning Header Bid

365. Plaintiffs allege that "last look" unfairly "re-routed trading from non-Google exchanges to AdX" by letting AdX "displace their trades by a penny."[695] Plaintiffs' experts echo this argument, with Professor Weinberg stating that "Dynamic Allocation enabled AdX to win impressions by bidding one cent above the header bidding clearing price"[696] and Professor Gans asserting that "last look increased AdX's probability of winning the impression."[697]

366. I interpret these allegations to mean that "last look" made an AdX bidder more likely to win (or pay less on average for) an impression than an otherwise similar bidder on a

[694] *See* Declaration of N. Jayaram (May 1, 2024), GOOG-AT-MDL-C-000017969, at ¶ 3 ("Before Google Ad Manager transitioned to a Unified First-Price Auction in 2019, Google Ads and DV360 never used a floor price in an auction for an ad impression to adjust the bid values that they would submit for that same ad impression.").

[695] *See* Fourth Amended Complaint ¶¶ 377-78 ("From the earliest days of header bidding, DFP let AdX peek at the winning net bid from an exchange using header bidding, then displace the trade by paying one penny more. Industry participants called this practice, along with Dynamic Allocation, Google's 'Last Look.' Other industries call analogous conduct by intermediaries 'insider trading' and 'front running.' According to a confidential Google study evaluating the effects on competition, Last Look significantly re-routed trading from non-Google exchanges to AdX and Google's ad buying tools, protecting Google's market power in both. Google itself admitted: 'Last Look is inherently unfair.' [...] These exchanges could now also peek at header bidding net bids and displace their trades by a penny.").

[696] *See* Expert Report of M. Weinberg (Jun. 7, 2024), at Section IV.B.2.b.

[697] Expert Report of J. Gans (Jun. 7, 2024), at ¶ 548.

non-Google exchange, even when those bidders have the same value for the impression.[698] Plaintiffs' and their experts' conclusions are based on an incorrect qualitative analysis: after properly accounting for bidder and publisher incentives, my economic analysis finds that the so-called "last look" did not provide AdX with an inherent advantage.

367. Plaintiffs' arguments ignore how publisher incentives affect their choices of floor prices. The claim that the so-called "last look" allowed AdX bidders to pay "a penny more" than the header bid tacitly assumes that AdX bidders could see the winning header bid as a floor price in AdX, but this is incorrect because any floor price determined by the header bidding line item could be *higher* than the bid itself. Indeed, publishers had an incentive to set floor prices that way, and there is evidence that publishers did just that.[699] Below, I correct the Plaintiffs' analysis by asking and answering three questions.

368. *First*, does the AdX second-price auction with a floor price based on winning header bids inevitably advantage AdX bidders? *No*.

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[698] That is, the highest willingness-to-pay among bidders on AdX and the non-Google exchange are equal.

[699] *See also* Product Requirements Doc, "PRD: Unified 1P auction and Pricing rules" (Jul. 25, 2018), GOOG-DOJ-03998505, at -506 ("We've anecdotally heard from some publishers that they inflate the value CPM of remnant line items."); Presentation, "First-price bidding" (Aug. 12, 2019), GOOG-DOJ-11406673, at -677 ("How boost works[:] The publisher inflates the HB bid before sending it as a floor to AdX[.] This is done to increase Adwords cost and to provide a better comparison between Adwords and header bidder bids[.]"). *See also* Email from [redacted] to [redacted] et al., "Unified Auction Changes (Sellside) Executive Update - Aug 12, 2019" (Aug. 13, 2019), GOOG-DOJ-09713317, at -319 ("Today, these [publisher-]inflated CPMs are used to provide price pressure for AdX [...] In practice, [...] many publishers [...] apply a boost to Header Bidding bids"); Presentation, "Changes to Ad Manager, AdMob auction" (Sep. 3, 2019), GOOG-DOJ-14549757, at -777 ("Last look [...] incentivizes pubs to inflate ('boost') the floor sent to AdX"); [redacted]

369. Header bidding auctions are typically first-price auctions. As I have argued in Section III.C.3.b, in first-price auctions, it is optimal for bidders to shade their bids: that is, an exchange that bids in a header bidding auction will bid less than the value of its highest bidder. For example, it might be optimal for an exchange to bid $1 for an impression in a first-price header-bidding auction when its highest bidder's value is $1.50. *If* the publisher uses that $1 bid as its floor price in AdX's second-price auction, the header bidder would lose the auction to an AdX advertiser who truthfully reports a value of $1.10, even though the AdX advertiser has the lower value. *But* the publisher could (and would have incentive to) reverse this effect by choosing a higher floor price for the AdX auction, which it can do by triggering a header bidding line item with a value CPM inflated above the header bidding offer. For example, if it triggers a line item with value CPM equal to $1.50—so that the AdX floor price is $1.50—then the AdX advertiser has *no advantage* from the so-called "last look": it loses because its bid of $1.10 falls below the floor price. Indeed, with a floor price of $1.50, an AdX bidder can only win if it is willing to pay at least $1.50 for the impression, which is the same as the bid it would need to win a (hypothetical) second-price auction combining bids from header bidders and AdX. If the publisher chose an even higher floor price than $1.50, the AdX bidder would be *disadvantaged*. As Professor Weinberg notes, publishers could readily configure header bidding to more generally implement this bid adjustment procedure.[700]

[700] A publisher could set the value CPM of each header bidding line item as a function of the header bid or by passing a header bid inflated directly on the end user's browser. *See* Expert Report of M. Weinberg (Jun. 7, 2024), at ft. 141 ("Publishers had the ability to increase the clearing price passed on from their header bidding setup to DFP, such as with a multiplier, or an added value."). *See* Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶¶ 14 ("Up until at least December 2021, the winning bid from the Header Bidding auction was typically used to trigger a specific line item that the publisher had booked within Google's ad server (most commonly a remnant line item), and […] the Value CPM of that line item could represent the winning Header Bidding bid as a floor in the AdX auction (prior to September 2019) or as a competing bid in the Unified First Price Auction (from September 2019 onwards)."), 11 ("Some publishers set Value CPMs higher than their estimates of what CPM a line item would likely generate to increase competitive pressure in the AdX auction or for other

370. *Second*, does a publisher using header bidding have an *incentive* to increase AdX floor prices as just described, reducing or reversing the claimed "last look" advantage? *Yes.*

371. In a second-price auction, it is always profitable for a publisher to trigger an AdX floor price higher than the highest header bid. In the above example, the publisher who has a $1 winning header bid in hand is *guaranteed* to sell the impression for $1 simply by allocating the impression to the winning header bidder. *If* the publisher uses that $1 bid as its floor price in AdX's second-price auction, then the publisher gains only when at least *two* bids in AdX's second-price auction are above $1. *But* the publisher can always do better: for instance, by triggering a header bidding line item with a value CPM of $1.01, the publisher gains when at least *one* bid in AdX's second-price auction is above $1. Of course, the publisher can do even better by setting the *optimal* value CPM based on the publisher's probabilistic assessments about bids in the AdX auction or based on experiments that it may run. A textbook result in auction theory implies this: it is always optimal for a seller to set an auction's floor price higher than its value for the item outside the auction.[701]

372. *Third*, if a publisher chooses floor prices *optimally* to maximize its average revenues and advertisers bid to maximize their profits, are AdX bidders always advantaged compared to header bidders as a consequence of the so-called "last look"? *No.*

reasons."). *See also* Asmaâ Bentahar, "Bid Adjustments Simplified: Run Fair Auctions with no Hassle," Pubstack (May 2, 2021), https://www.pubstack.io/topics/bid-adjustments-simplified ("Alternatively, this next one will slightly increase all returned CPMs, giving Prebid an edge in the competition against GAM").

[701] Krishna, V. (2010). *Auction theory* (2nd ed.). Academic Press, at 23 ("[A] revenue maximizing seller should always set a reserve price that exceeds his or her value.") (emphasis omitted).

373. In Theorem 3 below, I show that, in a standard model of auctions and the same one that Plaintiffs' expert Professor Weinberg recommends,[702] when all participants maximize their payoffs, AdX bidders enjoy no advantage over header bidders arising from the so-called "last look."

374. **Theorem 3:** Suppose that (i) a publisher sells an impression to a fixed set of bidders, including bidders on AdX; (ii) the publisher does not know each bidder's value for the impression; (iii) bidders do not know each other's values for the impression; and (iv) all participants understand the rules and have the following information:

a. Each bidder knows its own value for the impression.

b. Each bidder's value is drawn from a commonly-known probability distribution[703] and is statistically independent from other bidders' values.[704]

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[702] *See* Expert Report of M. Weinberg (Jun. 7, 2024), at ft. 40 ("In the context of the auctions for online display ads, I believe it is best to conduct the analysis assuming that advertisers have independent private values for impressions. The only exception is when I consider the potential impact of Enhanced Dynamic Allocation on direct deals in Section IV."). *See also* Expert Report of M. Weinberg (Jun. 7, 2024), at ft. 62 ("I assume for the majority of this report that the advertisers have independent private values for impressions (the only exception is when identifying a potential impact of Enhanced Dynamic Allocation on direct deals in Section IV). This is a simplifying assumption (it is likely that no auction in real life purely abides by the independent private values model) that makes the analysis more tractable, and it is a sensible assumption to make since (a) internal Google documents demonstrate that Google assumes this as well (e.g., GOOG-AT-MDL-004016180), (b) bidders are heterogeneous in their valuation for impressions (the impression from an avid runner is valued differently by Nike and McDonald's) and since the bidders do not know each other's identities, even if they learn about others' bids it could possibly not be that useful towards determining their own valuation."). *See also* Expert Report of M. Weinberg (Jun. 7, 2024), Appendix D at ¶ 6 ("Consider an auction in the independent private values model where there are 2 bidders whose values are each drawn independently and uniformly from [0,10].").

[703] I assume that this probability distribution satisfies a technical condition called "Myersonian regularity," described in Section XV.D, which ensures that the optimal mechanism for selling the impression is an auction.

[704] This implies that each bidder and the publisher can make a probabilistic assessment about other bidders' values and estimates of other bidders' values would not be changed upon learning one bidder's value.

c. Each bidder determines a bid as a function of its value to maximize its surplus from the impression, given its probabilistic assessments about the bids of other bidders.

Then, if the publisher chooses revenue-maximizing floor prices, it earns exactly the *same* expected revenue with a single unified second-price auction with all bidders participating as it would with first-price header bidding auction followed by a second-price auction for AdX.[705] Moreover, given those optimal floor prices, each header bidder has the same chance of winning and the same expected surplus as an identical bidder on AdX.

375. A proof of Theorem 3 can be found in Section XV.D. The intuition for the result is that, after receiving the bids from header bidders, publishers can ensure that a bidder on AdX wins only if its value is higher than those of all header bidders, by committing to choose a floor price in the second-price auction that reflects the highest value among header bidders. This means the publisher can ensure that the highest value bidder wins under each auction format, resulting in the efficient allocation above the floor price and—by the Revenue Equivalence Theorem that applies in this setting (see Paragraph 254)—the same profit-maximizing revenues under the two auction formats.

376. Theorem 3 demonstrates that the so-called "last look" need not necessarily offer any advantage to AdX (or any other ad exchange) when publishers boost header bids and all parties respond to their incentives. Professor Weinberg acknowledges publisher incentives to boost header bids, but argues that such behavior requires a degree of

[705] More specifically, the theorem considers an auction game in which the publisher moves first, the header bidders second, and AdX bidders last. The publisher selects header bidding floor prices and a function to map each header bid it receives into a floor price for the AdX auction; the header bidders select their bids; and then finally the AdX auction is run.

"sophistication."[706] However, because ad revenue is a significant source of income for many publishers, I expect them to reason through and experiment with various sensible pricing strategies. As I previously noted, documents suggest that publishers *did* "inflate[] the HB bid before sending it as a floor to AdX"[707] in practice and, as Professor Weinberg writes himself, some of the most popular header bidding tools readily provided publishers with the functionality to boost bids.[708] Although there could have been some publishers

[706] *See* Expert Report of M. Weinberg (Jun. 7, 2024), at ft. 165 ("The impact of Dynamic Allocation with sophisticated publishers who cleverly set Value CPMs is less clear-cut. On one hand, if sophisticated publishers only slightly inflate the Value CPM of the winning header bid, then the above conclusions continue to hold for exactly the same reasons. On the other hand, if sophisticated publishers significantly inflate the Value CPM of the winning header bid due to Dynamic Allocation and would not have set such an inflated reserve on AdX in absence of Dynamic Allocation, then the cost of this inflated reserve might outweigh the benefits highlighted above."). *See also* Expert Report of M. Weinberg (Jun. 7, 2024), at ft. 221 ("This is my opinion in aggregate, after considering that some publishers used default options while others were sophisticated and increased Value CPMs of header bids to boost AdX's reserve.").

[707] *See also* Product Requirements Doc, "PRD: Unified 1P auction and Pricing rules" (Jul. 25, 2018), GOOG-DOJ-03998505, at -506 ("We've anecdotally heard from some publishers that they inflate the value CPM of remnant line items."); Presentation, "First-price bidding" (Aug. 12, 2019), GOOG-DOJ-11406673, at -677 ("How boost works[:] The publisher inflates the [header bidding] bid before sending it as a floor to AdX[.] This is done to increase Adwords cost and to provide a better comparison between Adwords and header bidder bids[.]"). *See also* Email from R. Srinivasan to B. Bender et al., "Unified Auction Changes (Sellside) Executive Update - Aug 12, 2019" (Aug. 13, 2019), GOOG-DOJ-09713317, at -319 ("Today, these [publisher-]inflated CPMs are used to provide price pressure for AdX [...] In practice, [...] many publishers [...] apply a boost to Header Bidding bids"); Presentation, "Changes to Ad Manager, AdMob auction" (Sep. 3, 2019), GOOG-DOJ-14549757, at -777 ("Last look [...] incentivizes pubs to inflate ('boost') the floor sent to AdX"); [redacted]

[708] A publisher could set the value CPM of each header bidding line item as a function of the header bid or by passing a header bid inflated directly on the end user's browser. *See* Expert Report of M. Weinberg (Jun. 7, 2024), at ft. 141 ("Publishers had the ability to increase the clearing price passed on from their header bidding setup to DFP, such as with a multiplier, or an added value."). *See* Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶¶ 14 ("Up until at least December 2021, the winning bid from the Header Bidding auction was typically used to trigger a specific line item that the publisher had booked within Google's ad server (most commonly a remnant line item), and […] the Value CPM of that line item could represent the winning Header Bidding bid as a floor in the AdX auction (prior to September 2019) or as a competing bid in the Unified First Price Auction (from September 2019 onwards)."), 11 ("Some publishers set Value CPMs higher than their estimates of what CPM a line item would likely generate to increase competitive pressure in the AdX auction or for other reasons."). *See also* Asmaâ Bentahar, "Bid Adjustments Simplified: Run Fair Auctions with no Hassle," Pubstack (May 2, 2021), https://www.pubstack.io/topics/bid-adjustments-simplified ("Alternatively, this next one will slightly increase all returned CPMs, giving Prebid an edge in the competition against GAM").

who did not boost header bids in this manner, it is possible that boosting would have small effects on those publishers' revenues, or that they addressed the differences between exchanges' auction formats through other means, such as increasing the AdX specific floor price or using rebates (which I discuss more generally in Section XIV.E.3). Furthermore, Plaintiffs' analyses provide no evidence to support their assumption that publishers did not systematically boost header bids.

377. Even when the assumptions of Theorem 3 are not satisfied, publishers can use similar strategies to inflate value CPMs into AdX if they wish, or other strategies that are even more profitable for them. Any residual advantage or disadvantage for AdX then arises as a result of publishers' decisions to maximize profits, rather than from the so-called "last look."

3. Plaintiffs' and Their Experts Significantly Overstate the Effects of Line Item Caps

378. Since 2013, Google's ad server has limited the maximum number of active line items to 61,000[709] in order "to protect the health of the product [and] the performance of [Google's] system."[710] Plaintiffs and their experts assert that this limit "throttles

[709] Comms Doc, "Limits Enforcement" (Feb. 16, 2018), GOOG-DOJ-09494195, at -198 ("Number of active line item limits (please note: Each creative-level targeting criterion counts also toward the active line item limit[:] 61,000").

[710] Comms Doc, "Limits Enforcement" (Feb. 16, 2018), GOOG-DOJ-09494195, at -195 ("In 2014, we have started enforcing limits on the creation of certain entities in the DFP Ul, e.g. Lls per order, Creatives per LI, Ad units for placements and Targeting attributes in line items. [...] Limits are necessary in order to protect the health of the product, the performance of our system, and are ultimately for the benefit of all publishers and the performance of their Ul (unlimited number of entities can affect the Ul in terms of load time and serving in some cases). NOTE: Our limits are much higher than those that existed previously in DART.").

publishers' use of header bidding by artificially capping publishers [*sic*] use of 'line items'[...]" but their conclusions are flawed for several reasons.[711]

379. *First,* in dismissing Google's rationale for the caps as "pretextual," Professor Gans mischaracterizes the documents on which he claims to rely.[712]

a. Professor Gans argues that Google's "true motives" could not have been grounded in technical constraints because, in a 2017 email exchange, one Google employee remarked that "we may need to figure out the real hard limit."[713] However, the entire email exchange seems to concern a "system [] instability" and infrastructure issue arising from a publisher (CBS) that had over *one million* line

[711] Fourth Amended Complaint ¶ 389. *See also* Expert Report of J. Gans (Jun. 7, 2024), at ¶ 634 ("The third way in which Google impaired the use of its ad server products was by imposing restrictions on 'line items' to limit the use of Header Bidding by publishers. Line items were ad server settings that publishers used in order to customize their ad servers, most notably to enable Header Bidding. As explained previously, Header Bidding was a key facilitator of competition for the inventory between AdX and third-party exchanges. Google imposed restrictions on the number of line items publishers could use ('line item caps'), in an effort to limit the adoption of Header Bidding."). *See also* Expert Report of P. Pathak (Jun. 7, 2024), at ¶ 149 ("Google also could use the ad server technology to impede the use of Header Bidding through line-item caps.").

[712] Expert Report of J. Gans (Jun. 7, 2024), at ¶ 646 ("Google's motive in imposing limits to the number of line items available to publishers, and denying requests for those limits to be raised, was to restrict competition in the ad exchange market by making Header Bidding more difficult and costly to the largest and most important publishers. While Google offered various technical explanations for the caps, these were pretextual.").

[713] Expert Report of J. Gans (Jun. 7, 2024), at ¶ 647 ("Google communications make clear that the true motives for limiting line items was to prevent Header Bidding, rather than technical costs. A 2017 email explains that Google needs to "figure out the real hard limit.").

items at the time.[714] While Professor Gans interprets the employee's comment as refuting the need for a cap, the full conversation confirms in detail how [redacted] configuration presented "a real danger for the stability of [Google's] system" that required setting guard-rails to ensure consistently stable performance.[715]

b. Professor Gans then interprets another email exchange to suggest that reducing the number of line items would "limit Header bidding."[716] But that same exchange notes that "10k is more than enough line items for a HB setup, so I don't think ALI limits will be a motivator to move pubs off," and finds that reducing the number of active line items would likely have little impact on publishers, with

[714] Email from [redacted] to [redacted], "Re: [URGENT]: [redacted] hit their total line item limit" (March 29, 2017), GOOG-DOJ-15442474, at -474 to -479 ("[redacted] wants to increase their total LI limit from 1,000,000 to 1,200,000 asap [...] 1. Why do inactive/archived lines count towards the total limit? Infrastructure. Is what it is for now, unfortunately [...] Confirmed that header bidding caused this: [...] That order has 300k lines! [...] That sample order I found has around 300-400 lines but the story is that there are a bunch of orders related to header bidding causing this. [...] I don't think we should subject our system to instability due to this type of setup. [...] we may even need to get eng/pm director-level input to figure out how to handle and communicate this to pubs. [...] Non-active line items don't stress ad-serving or IM/F but they would stress Frontend, API and reporting. For Frontend, we have to search, sort and filter across all of these line items. So this does affect performance. External API requests would also need more resources and time to process. Imagine an external API script dumping all line items (which pubs often do). [...] Reporting also needs to deal with any line item that ever served an impression so I am assuming more line items would mean greater load but don't know specifics. [...] [redacted] is right in that this represents a real danger for the stability of our system.").

[715] Email from [redacted] to [redacted], "Re: [URGENT]: [redacted] hit their total line item limit" (March 29, 2017), GOOG-DOJ-15442474 ("[redacted] is right in that this represents a real danger for the stability of our system.").

[716] Expert Report of J. Gans (Jun. 7, 2024), at ¶ 649 ("In 2018, Google employees again explained their methods to limit Header Bidding. In a 2018 email exchange, it seems that the costs for Google of doing so are limited ('(some) cost on us') and that resources can be saved some other ways ('purging active LI that aren't really active is something we should do anyway').").

about a quarter of line items that were active for six months or longer having no impressions in six months.[717]

c. Professor Gans also claims that "Google declined many publishers' access to additional line items despite its ability to do so,"[718] but he forms his conclusion on anecdotal evidence that ignores the many exemptions that Google *did* provide to publishers. In the data I have reviewed, at least [redacted] publishers are approved to set more than 61,000 active line items. For example, both [redacted] and [redacted] can set up to [redacted] active line items.[719]

380. Other documents cited by Professor Gans confirm that Google had legitimate concerns about how publisher configurations imposed costs and created a strain on Google's infrastructure. In an email thread he cites, Google employees note that "we h[a]ve seen growth in inventory complexity (steadily) for >2 years. This required us to refactor our

[717] Email from N. Korula to [redacted] et al.,, "Re: ALI limits/ fee" (Oct. 8, 2018), GOOG-DOJ-15127000 from -000 to -004 [redacted]

[718] Expert Report of J. Gans (Jun. 7, 2024), at ¶ 651 ("Google only partially provided publishers with more line items via exceptions. In August 2018, Google launched a new process for publishers to request line item limit exceptions. Google notes that requesting an exception does not guarantee a publisher access to more line items. Google declined many publishers' access to additional line items despite its ability to do so[...].").

[719] These findings follow from my analysis of the "GAM Publisher Active Line Items Data" at GOOG-AT-EDTX-DATA-001116098, in which I logged the number of NetworkIds with a Limit larger than 61,000, in addition to the Limit for entries named '[redacted] The relevant code is in code/line_item_capping.py in my supporting materials, and the output is saved in code/logs/line_item_capping.txt.

serving infrastructure for retrieving LI/CLT. The new infrastructure scales well, all we need to support continued growth is more resources (which itself is an issue...)[.] [redacted] We mitigate and resolve these as they come up -- but it highlights the cost of allowing unrestrained growth. It comes with a cost, and we have to impose limits."[720] An additional document I reviewed noted a publisher with '[redacted] active [line item]s that put a huge strain on [Google's] system []."[721] Altogether, Professor Gans' assertion that technical considerations were "pretextual" is inconsistent with the themes of these emails and documents.

381. *Second,* despite Plaintiffs repeated emphasis of the line item limit, the data I analyze suggests that few publishers approach this threshold in practice. While Professor Pathak states that some "large publishers needed to create thousands of line items" in order "to run their Header Bidding arrangements," he ignores that GAM's 61,000 line item limit *did* accommodate "thousands" of line items.[722] In October 2016, when Google evaluated the effect of strictly enforcing the line item cap, it found that just four publishers would be affected.[723] My analysis of GAM data from April of 2024 is consistent with that document and found that over [redacted]% of publishers utilize less than [redacted]% of their active

[720] *See* Email from [redacted] to [redacted] et al., "Re: Ultraprio - Increase the ALI for Turner" (Sep. 26, 2018), GOOG-TEX-00090969, at -970.

[721] *See* Comms Doc, "Limits Enforcement" (Feb. 16, 2018), GOOG-DOJ-09494195, at -202.

[722] Expert Report of P. Pathak (Jun. 7, 2024), at ¶ 149 ("As I understand, to run their Header Bidding arrangements, some large publishers needed to create thousands of line items, which represent potential Header Bidding price points in DFP.").

[723] Comms Doc, "Limits Enforcement" (Feb. 16, 2018), GOOG-DOJ-09494195, at -201 ("Please note that as of Oct 2016, we only have [redacted] DFP publishers exceeding this limit and those are being closely monitored by Eng to ensure no negative repercussions are happening on our serving infrastructure.").

line item limit.[724] If the granularity of line items were as significant of an issue as Plaintiffs pose, one would expect the number of publishers near capacity to be substantially higher. Documentation of the popular header bidding wrapper Prebid.js echoes this finding, with the highest granularity option using just 2,001 line items per exchange.[725]

382. *Third,* as noted by Professor Gans, in 2021, Google began to roll out Header Bidding via Yield Groups (HBYG), which rendered it unnecessary for publishers to set up thousands of line items to call header bidding exchanges.[726] Professor Gans criticizes HBYG for "limited functionality" as it "only worked with the Prebid wrapper,"[727] but Prebid is "the most widely used header bidding 'container' or 'wrapper' on the web."[728] Moreover, publishers could use HBYG in conjunction with header bidding to reach the few partners who might not use Prebid. He also criticizes HBYG for being "confidential" during its

[724] These findings follow from my analysis of the "GAM Publisher Active Line Items Data" at GOOG-AT-EDTX-DATA-001116098. I calculate each publisher's percent utilization of its cap by dividing its "Active including creatives" by its "Limit," noting that over [redacted]% of values in this list are less than [redacted]%. The relevant code is in code/line_item_capping.py in my supporting materials, and the output is saved in code/logs/line_item_capping.txt.

[725] Prebid.org, "Prebid.js Ad Ops" (accessed Jul. 24, 2024), https://docs.prebid.org/adops/price-granularity.html#prebid-default-price-granularities.

[726] Expert Report of J. Gans (Jun. 7, 2024), at ¶ 657 ("With HBM, publishers no longer had to set up hundreds of line items for Prebid and could instead install Header Bidding via Yield Groups, similar to Open Bidding Yield Groups.").

[727] *See* Expert Report of J. Gans (Jun. 7, 2024), at ¶ 658 ("HBM did not fully solve the issue of publishers requesting line item limit exceptions as it had limited functionality. HBM only worked with the Prebid wrapper and GPT tags, and as of March 2023, not all Header Bidding Ad Networks were supported by HBM.").

[728] Prebid.org, "About," (accessed Jul. 25, 2024), https://prebid.org/about.

pilot,[729] even though it is not unusual for firms to keep programs in pilot confidential. In April of 2022, HBYG was announced as a public product.[730]

383. *Fourth,* Plaintiffs' and their experts' descriptions of how header bidding functions are factually incorrect. Plaintiffs pose a hypothetical in which "a publisher receives a header bidding exchange bid of $4.29, but only has a pre-existing line item with a price of $4.20, then the publisher's Google ad server rounds down the header bidding bid to the line item with the next closest price, e.g., to the line item with the price of $4.20,"[731] asserting that "[f]ewer line items cause publishers' bids from header bidding exchanges to be rounded down more often," leading publishers to "receive less revenue when a header bidding exchange wins."[732] This is wrong for two reasons.

i. Rounding a winning header bid does not affect the payment amount from the exchange. When a header bidding exchange offers $4.29 and wins, the publisher receives $4.29 regardless of whether the publisher triggered a $4.30 or $4.20 line item in GAM.[733, 734]

[729] Expert Report of J. Gans (Jun. 7, 2024), at ¶ 658 ("Moreover, HBM adoption was slow as it was available in GAM 360 only and remained confidential as only a couple of publishers were progressively enrolled. Moreover, Google tried to keep HBM confidential but was noticed by some bidders.").

[730] *See* Google Ad Manager Blog, "Improved header bidding support in Google Ad Manager" (Apr. 27, 2022), https://blog.google/products/admanager/improved-header-bidding-support-in-google-ad-manager/.

[731] Fourth Amended Complaint ¶ 390. *See also* Expert Report of J. Gans (Jun. 7, 2024), at ¶ 661 ("If a publisher receives a bid of $5.20 from an exchange using Header Bidding, but the publisher only has a pre-existing line item with a price of $5, then Google's ad server rounds down the Header Bidding bid to the line item with the next closest price (in this case, $5).").

[732] Fourth Amended Complaint ¶ 394.

[733] *See, e.g.*, Prebid.org, "Price Granularity" (accessed Jul. 12, 2024), https://docs.prebid.org/adops/price-granularity.html ("Important: Rounding does not impact the price paid, only the auction on the ad server. For example, if your bid for 2.75 is rounded down to 2.50 and wins on the ad server at 2.50, you will be paid 2.75.").

[734] This example omits the additional issue of payment discrepancies in header bidding. As I discuss further in Section X, there were reports of payment discrepancies, where publishers' expected receipts from header bidders did

ii. Plaintiffs' allegations overlook publishers' incentives to increase the AdX floor price above header bids. In the hypothetical described above, *even if* the line item cap required the publisher to use less granular floor prices, Plaintiffs are wrong to assume that the publisher rounds down to $4.20. Instead, as I discussed above, the publisher would be incentivized to *round up* the header bid to $4.30 or to inflate the bid even more. Because header bidding was a publisher-configured technology, publishers could trigger line items with value CPMs higher than header bids. Additionally, header bidding wrappers such as Prebid.js provided publishers with the functionality to round bids *up* rather than *down*.[735] As I have explained in Section XIII.D.2, configuring header bidding to trigger increased floor prices is consistent with publishers' incentives and can make bids from header bidding exchanges *more* competitive, not "less competitive compared to the bids from Google [...]."[736]

4. Plaintiffs and Their Experts Misinterpret Google's Experiments on "Last Look"

384. Plaintiffs and their experts' claim that Google experiments predicted that removing the so-called "last look" would have reduced the revenues of AdX, Google Ads, and DV360.[737] Plaintiffs' and Professor Gans' allegations appear to refer to experiments

not match the eventual payments. *See* Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 24 ("Header bidding is also not transparent because, although the publisher 'accepts' the impression at a certain price, the header bidder may not actually pay the sum indicated in its bid.").

[735] Prebid.org, "Prebid.js Publisher API Reference" (accessed Jul. 24, 2024), https://docs.prebid.org/dev-docs/publisher-api-reference/setConfig.html#setConfig-Cpm-Rounding ("Prebid also allows setting a custom rounding function. This function will be used by Prebid to determine what increment a bid will round to.").

[736] Fourth Amended Complaint ¶ 394.

[737] *See* Fourth Amended Complaint ¶ 382 ("Truly giving up Last Look would have cost Google too much; Google predicted a 10 percent hit to DV360's revenue and at least a 30 percent decrease in Google Ads' revenue."). *See also* Expert Report of J. Gans (Jun. 7, 2024), at ¶ 609 ("Google conducted experiments to assess the significance of the

summarized in an internal presentation during the transition to the Unified First Price Auction.[738] However, that experiment tested just one way in which the so-called "last look" could be removed, which was to remove remnant line items from the calculation of the floor price for the AdX second-price auction.[739] By itself, that change would reduce AdX's win rate: it would reduce AdX floor prices (because remnant line items could no longer increase those floor prices) and thus reduce the AdX clearing price (because the AdX floor sometimes set the clearing price in the AdX second-price auction). And because, in the experiment, the AdX clearing price was compared to other exchanges' bids, lower AdX clearing prices would translate into fewer wins for AdX bidders.

385. Plaintiffs treat the experimental results as evidence of how the industry would have evolved without the so-called "last look," but this analysis incorrectly assumes that the only way for Google to "remove" the so-called "last look" was the one tested in the experiment.

'Last Look' advantage before migrating to a first-price auction system. An internal document shows an [redacted]% decrease in AdX revenue and [redacted]% decrease in impressions due to giving up 'Last Look.'").

[738] Professor Gans cites an email exchange dated August 29, 2019 (*See* Email from [redacted] to [redacted] et al., "Re: Unified Auction Changes (Sellside) Executive Update - Aug 12, 2019," GOOG-TEX-00682264). The relevant quote states "On second-price traffic, this results in a [redacted]% decrease in AdX revenue [...] and a [redacted]% decrease in impressions." Although it is not possible to be certain, that email appears to be reporting results from the same analyses that were presented in a slide deck dated September 3, 2019 and titled "Changes to Ad Manager, AdMob auction" (Sep. 3, 2019), GOOG-DOJ-AT-02204351. Slide -382 of the presentation, titled "Last look removal (AdManager app & web)," contains near-identical text: "On second-price traffic, this results in a [redacted] decrease in AdX revenue and impressions."

[739] The title of the experiment cited in Presentation, "Changes to Ad Manager, AdMob auction" (Sep. 3, 2019), GOOG-DOJ-AT-02204351, at -359 is [redacted] which is the basis for my understanding that remnant line items were removed from the calculation of the AdX clearing price.

386. The same document contains evidence that there were alternatives: AdX buyers could win more often by using a "Bid Translation service" to optimize their bids to compete against bids from other exchanges in a subsequent first-price auction.[740] And when Google ultimately removed the so-called "last look" over remnant line items, it did choose an alternative: it transitioned to the Unified First Price Auction, which avoided the adverse impacts of the change tested in the experiment.[741] As Plaintiffs concede themselves, after AdX *optimized* its bids to better compete against other exchanges, the changes were "revenue neutral" compared to the period in which it had a "last look,"[742] which suggests that there was no inherent advantage to "last look."

387. Moreover, as observed by the employee in the email exchange that Professor Gans cites, there are a number of short-term effects that make it "difficult" to interpret the results of the experiment. The employee notes various challenges, such as there being "[s]ome buyers [that] are experimenting with 'smart' / first-price bidding algorithms," and publishers who "inflate the CPMs of Header bidding line items."[743] These are typical limitations of short-run experiments. After participants adjust to the new incentives of the

[740] *See* Presentation, "Changes to Ad Manager, AdMob auction" (Sep. 3, 2019), GOOG-DOJ-AT-02204351, at -362.

[741] I discuss Google's transition to the Unified First Price Auction further in Section XIV.

[742] *See* Fourth Amended Complaint ¶¶ 379-82 ("Several years later, in 2019, Google publicly announced that exchanges in Exchange Bidding would no longer be able to trade ahead of header bidding exchanges[.] […] Google compounded this Exchange Bidding advantage with a new secret bid optimization scheme that allowed Google to recapture the advantages it had under Last Look[.] […] Internal Google documents reveal that these changes were [redacted] for DV360 [redacted] percent) and Google Ads [redacted] percent).").

[743] Email from [redacted] to [redacted] et al., "Re: Unified Auction Changes (Sellside) Executive Update - Aug 12, 2019" (Aug. 29, 2019), GOOG-TEX-00682264, at -265 ("Some buyers are experimenting with 'smart' / first-price bidding algorithms. Quantifying the effect of these is difficult, since buyers are using the transition period to develop and test new algorithms. Additionally, there is a long-term benefit of publishers having reduced incentives to inflate the CPMs of Header bidding line items. Today, these inflated CPMs are used to provide price pressure for AdX, which can result in increased publisher revenue. In a first-price auction, such inflation can only lead to reduced publisher revenue, so this inflation is expected to decrease over time.").

first-price auction, the actual revenue outcomes may differ from the outcomes in the experiment.

XI. RESERVE PRICE OPTIMIZATION: INCREASING PUBLISHER REVENUES IN "THIN" AUCTION MARKETS

A. Overview

388. Reserve Price Optimization (RPO) was an AdX feature designed to help publishers "earn the most money possible, with the least complexity."[744] Launched as Optimized Pricing in April 2015,[745] RPO increased the floor price sent to a bidder on AdX when Google predicted—based on historical bid data—that a higher floor price would increase publisher revenues.[746] By increasing publisher yields, RPO also incentivized publishers to make more inventory available for programmatic auctions.[747] Google updated its RPO features over time and found that each update increased publisher revenues.[748] Other

[744] Comms Doc, "Optimized pricing in the Open Auction Comms" (Mar. 23, 2018), GOOG-DOJ-04937154, at -154 ("Our goal has always been to help publishers thrive and create sustainable businesses with advertising: to earn the most money possible, with the least complexity, all while providing users the best experience. [...] These new features will help our publisher partners grow their revenue and give programmatic buyers greater access to premium inventory.").

[745] Email from [redacted] to [redacted], "Re: [drx-pm] LAUNCHED! Dynamic Pricing (RPO) for AdX sellers" (Nov. 12, 2015), GOOG-DOJ-07235914, at -916 ("In April, we launched a simple pricing model that sets prices based on inventory features such as web property and ad unit.").

[746] Comms Doc, "Optimized pricing in the Open Auction Comms" (Mar. 25, 2016), GOOG-DOJ-04937154, at -158 ("So in recent months, we've been working on optimized pricing technology that algorithmically sets floor prices in the Open Auction to increase publisher revenue. With optimized pricing, we use event level data available from previous auctions to predict what the bids will be on certain queries, and adjust the floor price accordingly on behalf of the publisher, subject to their settings.").

[747] Presentation, "Reserve Price Optimization, Optimized Private Auctions & Dynamic Revenue Sharing" (Mar. 23, 2018), GOOG-AT-MDL-004242638, at -639 ("When publishers' programmatic yield grows, they make more inventory available to buyers.").

[748] Presentation, "AdX Dynamic Price" (Dec. 11, 2014), GOOG-DOJ-13199910, at -930 ("AdX pubs [...] Total [redacted]% (with GDN opt out)"; Launch Doc, "AdX Dynamic Price Optimization V2" (Sep. 16, 2015), GOOG-DOJ-13209957, at -959 ("The cookie model seems to add about [redacted]% incremental revenue."); Email from [redacted] to [redacted], "Re: [drx-pm] LAUNCHED! Dynamic Pricing (RPO) for AdX sellers" (Nov. 12, 2015), GOOG-DOJ-07235914, at -915 ("Between April and October we launched and improved new systems to dynamically set auction reserve prices for AdX sellers. After three launches and a three month study of the impact on buyers and sellers, the Reserve Price Optimization (RPO) program now generates a total annual revenue lift of [redacted], or [redacted]% of total network (AdX+AdSense publisher) revenue (rasta)!"); Launch Doc, "Online Reserve Price Optimization" (Sep. 14, 2017), GOOG-DOJ-13211589, at -590 ("The launch candidate increases network-wide revenue by +1.11%").

sell-side intermediaries (including [redacted] Magnite (formerly Rubicon), [redacted], and [redacted]) implemented features similar to RPO.[749]

389. Plaintiffs allege that RPO misled advertisers because it "meant that the auction did not operate as a sealed second price auction as Google had advertised."[750] But, as noted by Plaintiffs' experts Professors Weinberg and Pathak, a second-price auction *remains* a second-price auction with or without a program like RPO in place.[751] RPO was a service to automate and improve the ordinary publisher task of setting floor prices in a second-price auction; it did not change the format of the AdX auction.

390. Plaintiffs and their experts allege that some publishers and advertisers were harmed by Google's alleged "concealment" of RPO.[752] But RPO was designed to increase

[749] [redacted] Rubicon Project, "Maintaining the Equilibrium: How Dynamic Price Floors Preserve the Integrity of the Automated Advertising Ecosystem" (2014), GOOG-AT-MDL-011234683, at -696 ("Rubicon Project gives sellers the opportunity to employ a sophisticated Dynamic Price Floor algorithm which works above a seller's hard floors."); [redacted]

[750] Fourth Amended Complaint ¶ 532.

[751] Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 285 ("Note that each individual auction in isolation is still a second-price auction with reserve [...] .") (describing an example of the operation of RPO); Expert Report of P. Pathak (Jun. 7, 2024), at ¶ 191 ("As a result, even though AdX ran a second-price auction at the time [...] .") (discussing RPO's effects on advertiser bidding behavior).

[752] *See, e.g.*, Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 272 ("The negative effects of RPO to advertiser payoff, and possibly some publishers' revenues, at least partially stem from Google's concealment of the conduct."); Expert Report of P. Pathak (Jun. 7, 2024), at ¶ 191 ("As a result, by concealing RPO, Google interfered with the publishers' revenue maximization [...] As a result, both the publishers and the advertisers could act accordingly if they knew RPO was in effect. This potentially reduces their revenue or payoff compared to what they could have been."); Expert Report of J. Chandler (Jun. 7, 2024), at ¶ 360 ("It is my opinion that those undisclosed Google rule changes were contrary to the expectations of the auction participants and made it impossible for auction participants and competing exchanges to understand the rules that governed and applied to auctions run by Google, skewing decision-making and outcomes.") (discussing RPO, DRS v1, and Bernanke); Expert Report of J. Andrien at ¶¶

publishers' revenues, and it was successful at doing just that, with the initial versions of the program increasing publisher revenues on the order of [redacted]% and later updates increasing publisher revenues even further.[753] Plaintiffs and their experts do not provide actual examples of publishers claiming to be harmed by Google's RPO program, and nor am I aware of any such evidence. For advertisers, knowledge of RPO was not necessary for buy-side tools to optimize bids: in the absence of RPO, publishers could (and did[754]) use historical data to set floor prices,[755] so that a surplus-maximizing bidder would account for that possibility *both* when RPO was in place and before. Moreover, Google

34-35 ("For example, by concealing RPO, Google prevented publishers from effectively optimizing revenue, [...] Google also impacted advertiser behavior through its second-price auction representation and concealment of RPO.").

[753] [redacted]

[754] Comms Doc, "Optimized pricing in the Open Auction Comms" (Mar. 23, 2018), GOOG-DOJ-04937154, at -155 ("Optimized pricing in the Open Auction automates the post-auction analysis and floor price updates that publishers are already doing and takes it a step further."); "Buyer incentives and reserve price optimization" (May 14, 2012), GOOG-DOJ-15588979, at -979 ("No expectation of bid privacy: other platforms like yield managers [] already give publishers full buyer bid information and therefore the buyers might not care").

[755] Indeed, as I discuss in Paragraph 397, in 2011, Google provided a Minimum CPM Recommendation Feature that helped publishers select such floor prices more effectively.

disclosed RPO roughly a year after it launched,[756] so any potential impacts from the alleged "concealment" would have been short-lived.

B. Importance of Floor Prices for Revenue Optimization

391. As I discussed in Section III.C.3.d, floor prices can help publishers increase their average auction revenues.[757] A publisher contemplating an increase in its floor prices faces a tradeoff between *increasing* the average price of each impression sold and *reducing* the probability of a sale because no bidders meet the price floor. Because a publisher typically does not know each advertiser's willingness to pay for an impression or even which advertisers are participating in each auction, publishers can use historical data on the sales of similar items or experimentation (or both) to set floor prices. For example, with historical data on bids received in a second-price auction, a seller can simulate the outcomes of auctions with alternative floor prices and choose the one that those simulations indicate would generate the highest revenue.[758] Alternatively, a publisher could run an experiment or "A/B test" of different floor prices on live auctions, and choose the floor price that led to the highest revenue in those experiments.[759]

[756] Jonathan Bellack, "Smarter optimizations to support a healthier programmatic market," Google Ad Manager (May 12, 2016), https://blog.google/products/admanager/smarter-optimizations-to-suppor/ ("In our experiments to date, we have applied optimized pricing to about [redacted]% of transactions, creating over [redacted]% lift in revenue for publishers using the Open Auction. As we expand our experiments with optimized pricing, we will monitor its performance to ensure advertisers continue to get great ROI."). *See also* Email from [redacted] to AdX Buy-Side Global Sales et al., "[ANNOUNCED] Smarter optimizations for DoubleClick Ad Exchange" (May 12, 2016), GOOG-DOJ-04934481, at -481 ("On Thursday afternoon we announced new optimizations for DoubleClick Ad Exchange, Optimized Private Auctions and optimized pricing in the Open Auction (aka RPO).").

[757] Note, however, that badly-chosen floor prices (*i.e.*, floor prices chosen too high) can *reduce* average auction revenues.

[758] *See* Ostrovsky, M., & Schwarz, M. (2023). Reserve prices in internet advertising auctions: A field experiment. *Journal of Political Economy*, *131*(12), 3352-76..

[759] *See, e.g.*, Rhuggenaath, J., Akcay, A., Zhang, Y., & Kaymak, U. (2022). Setting reserve prices in second-price auctions with unobserved bids. *INFORMS Journal on Computing*, *34*(6), 2950-67.

392. Setting floor prices can be especially important in **thin** auctions, which are auctions with few competitive bidders.[760] This effect is seen most easily in second-price auctions because, in those types of auctions, a floor price can be effective at increasing the price of an impression *if and only if* there is a *single* bid above the floor price.[761] This is more likely to occur if there are fewer bidders, which is why floor prices are more important in thinner auctions.[762] Conversely, in second-price auctions with more bidders, floor prices are often less important because the price is more often set by the second-highest bid, rather than the floor price.

393. Although there are typically many advertisers participating in online display advertising auctions, there are several possible sources of auction thinness in display advertising.

394. *First*, not all bids from advertisers end up competing in the final auction for an impression. One reason for this is budget throttling, discussed in Section VI of this report, in which a buy-side tool selects a subset of its eligible advertisers for participation in each auction. Another reason, discussed in Section III.C.4 of this report, is that some buy-side tools submitted only one bid for an impression on behalf of multiple advertisers. Regardless of whether those bidding strategies benefit advertisers, they reduce the overall number of bidders participating for each impression, making it more likely that the publisher's floor price determines the clearing price of the impression.

[760] In this context, "competitive" bidders are those bidders with values for items that are close to the average sale price for the impression.

[761] The same result is true of first-price auctions, but for a different reason. In a first-price auction, each bidder's optimal bid depends on the number of competitive bidders in the auction and the floor price, with the optimal bid *lower* with *fewer* competitive bidders and *higher* when the floor price is *higher*. This makes the floor price a more important lever in first-price auctions with few competitive bidders.

[762] *See, e.g.*, Reiley, D. H. (2006). Field experiments on the effects of reserve prices in auctions: More magic on the internet. *The RAND Journal of Economics*, *37*(1), 195-211 ("The gains to setting an optimal reserve price become very small as [the number of bidders] increases.").

395. *Second*, auction thinness can arise as a result of finer targeting, a possibility I first discussed in an academic paper in 2010.[763] Finer targeting allows an advertiser to more accurately identify the end users it seeks to reach with its advertising campaign. As a result, the advertiser bids *more* for impressions that meet its targeting criteria but participates in *fewer* auctions overall. Because the price an advertiser pays in an auction depends on the competitive environment (including the total number of advertisers competing for the impression), finer targeting can reduce overall auction revenues, even though the winning advertiser's bid is increased. For example, suppose that there are ten Ford dealerships running online display ad campaigns in Dallas–Fort Worth but only one operating in Plano. If an impression opportunity can be associated with someone shopping for a car in Dallas-Fort Worth, all ten might bid for the impression. But if each advertiser can identify that the end user lives in Plano, only one might be interested in bidding. As a result, the publisher's revenue from the impression can be lower in the second case than the first. This possibility had been discussed internally at Google, where some engineers called it the "Pricing Paradox."[764] Google engineers identified a "solution" to the "Pricing Paradox": more accurate floor prices.[765]

[763] Levin, J., & Milgrom, P. (2010). Online advertising: Heterogeneity and conflation in market design. *American Economic Review: Papers & Proceedings*, *100*(2), 603-07, at 606 ("A second hazard of targeting is that it leads to thinner markets, which can create problems for accurate pricing.").

[764] Presentation, "The Pricing Paradox and solutions" (May 15, 2012), GOOG-DOJ-03366173, at -179 ("Pricing paradox[:] Targeting may create more value, less revenue").

[765] Presentation, "The Pricing Paradox and solutions" (May 15, 2012), GOOG-DOJ-03366173, at -188 ("Solution #2: Auctions with reserve prices [...] Compute revenue-maximizing reserve prices for each query bundle").

C. Google's Implementation of RPO

396. Over time, Google introduced a number of features to help publishers set floor prices leading to higher revenues in the AdX auction. In addition to improving programmatic revenues for its publisher customers, Google's revenue share model on AdX means that it also had an interest in setting floor prices leading to higher auction revenues.

397. In 2011, Google introduced a Minimum CPM Recommendation feature (internally called AdX Seller Reserve Price Optimization) for publishers.[766] The Minimum CPM Recommendation feature calculated optimal floor prices for each ad slot based on the previous week's bids on that ad slot and provided those as recommended floor prices in the publisher's AdX user interface, along with a graph of expected revenue for each floor price that the publisher could choose.[767] The publisher still needed to set the floor price manually in the AdX user interface based on its recommendations.[768] Google's early

[766] "AdX Seller Reserve Price Optimization" (Nov. 18, 2012), GOOG-DOJ-12439154, at -154 ("AdX Seller Reserve Price Optimization [...] Status: launched on Q2 2011").

[767] "AdX Seller Reserve Price Optimization" (Nov. 18, 2012), GOOG-DOJ-12439154, at -156 ("The approach is[:] 1. Process logs [redacted] moving window, updated daily) to extract first and second price statistics per ad slot[.] 2. Compute optimized floor prices for the next day"); Nemo Semret, "Introducing Minimum CPM Recommendations on DoubleClick Ad Exchange," DoubleClick Publisher Blog (Nov. 1, 2011), https://doubleclick-publishers.googleblog.com/2011/11/introducing-minimum-cpm-recommendations.html ("Today, we're happy to announce the launch of Minimum CPM Recommendations for DoubleClick Ad Exchange publishers. This feature automatically recommends an optimal minimum cpm for each eligible ad slot in the Ad Exchange auction. It also automatically generates a graph that provides better visibility into how different floor prices might affect a publisher's bottom line.").

[768] Design Doc, "Dynamic Floor Prices in AdX" (Aug. 20, 2012), GOOG-AT-MDL-010338120, at -120 ("Floor prices in AdX are set manually per ad unit (or, in the brave new adunitless world, per inventory rule). Either way, the min cpm is set by a human entering a number into a text box in the adseller UI.").

experiments found that publisher revenues increased approximately [redacted]% on the ad slots on which its recommended floor prices were adopted.[769]

398. Despite its Minimum CPM Recommendation feature and other strategies used by publishers to increase auction clearing prices,[770] by 2015, Google found that "even with all this effort, there [was] still a wide and persistent price gap between the bid and closing prices in the open auction across all [] publishers."[771] Some Google engineers referred to that gap as the "auction discount" because (in a second-price auction with optimal bids) it is the difference between the bidders' willingness-to-pay and the price it actually paid.[772] Google engineers measured the "auction discount" in 2015, and found that [redacted].[773]

[769] Nemo Semret, "Introducing Minimum CPM Recommendations on DoubleClick Ad Exchange," DoubleClick Publisher Blog (Nov. 1, 2011), https://doubleclick-publishers.googleblog.com/2011/11/introducing-minimum-cpm-recommendations.html ("Initial results with early beta testers indicate an average 20% revenue lift for adopted recommendations.").

[770] For example, one Google document notes that "publishers have created complex systems of publisher-set floors to close the gap. Unfortunately, these floors are hard to calculate manually, requiring ad ops teams to spend countless hours gathering data and running post-auction analysis to update pricing and priorities in their system. Some publishers have even resorted to more extreme methods like waterfalls between exchanges, which introduces latency that damages consumer experience and advertiser performance." Comms Doc, "Optimized pricing in the Open Auction Comms" (Mar. 23, 2018), GOOG-DOJ-04937154, at -155.

[771] Comms Doc, "Optimized pricing in the Open Auction Comms" (Mar. 23, 2018), GOOG-DOJ-04937154, at -155.

[772] "Cookie based Dynamic Reserve Price Optimization (RPO) - mini PRD" (May 1, 2015), GOOG-DOJ-13203511, at -511 ("There is often a [redacted] a gap between what buyers are bidding and what they end up paying when the auction closes.").

[773] "Cookie based Dynamic Reserve Price Optimization (RPO) - mini PRD" (May 1, 2015), GOOG-DOJ-13203511, at -511 ("On average buyers pay less than half of what they bid. [redacted]").

399. In April 2015, Google introduced its AdX Dynamic Price feature (later simply called RPO, which is the term I will use for the program).[774] RPO *automatically* increased floor prices for publishers with the simple goal of helping publishers "earn the most money possible, with the least complexity."[775] Google engineers noted that RPO could also "encourage publishers to make more inventory accessible to the open auction."[776] RPO also responded to auction "thinness" created by the one-bid policies chosen by some buy-side tools participating in the AdX auction (see Section III.C.4). As one Google engineer noted, "A dynamic RPO floor effectively recovers some of the money lost by the fact that some bidders[,] say [C]riteo, aren't sending a second bid, they are just sending [one]."[777]

400. The first RPO model (sometimes called Per-Buyer RPO) increased floor prices on a per-buyer basis, using data on the buyer's bids on a publisher's ad slot from the previous day to estimate the floor price that maximized the expected auction revenue.[778] In October 2015, Google added Cookie-Based RPO, which used the previous day's data on a buyer's

[774] Email from [redacted] to [redacted], "Re: [drx-pm] LAUNCHED! Dynamic Pricing (RPO) for AdX sellers" (Nov. 12, 2015), GOOG-DOJ-07235914, at -916 ("In April, we launched a simple pricing model that sets prices based on inventory features such as web property and ad unit.").

[775] Comms Doc, "Optimized pricing in the Open Auction Comms" (Mar. 23, 2018), GOOG-DOJ-04937154, at -154 ("Our goal has always been to help publishers thrive and create sustainable businesses with advertising: to earn the most money possible, with the least complexity, all while providing users the best experience,"), -155 ("Optimized pricing effectively reduces the gap between the first price and closing price increasing publisher yield. Optimized pricing could encourage publishers to make more inventory accessible to the open auction as well as reduce complex setups with varying ad server priority and floor prices[.]").

[776] Comms Doc, "Optimized pricing in the Open Auction Comms" (Mar. 23, 2018), GOOG-DOJ-04937154, at -155.

[777] "Notes: MTV/LON/CAM Strategy Summit" (Aug. 12, 2015), GOOG-DOJ-10572595, at -603.

[778] Email from [redacted] to [redacted], "[Launch 124105] Per-buyer dynamic reserve price optimization on AdX - full launch (+$[redacted] annual revenue from RTB buyers)" (Nov. 13, 2014), GOOG-DOJ-15419945, at -945; Presentation, "AdX Dynamic Price" (Dec. 11, 2014), GOOG-DOJ-13199910, at -920 ("Daily pipeline to compute pricing file based on 'yesterday' data), -925 ("Compute bid distributions for 'yesterday'[.] Find 'optimal' reserve prices[...]").

bids for a given cookie to estimate revenue-maximizing floor prices for impression opportunities associated with that cookie.[779] Cookie information was included in the RPO model because Google found that "[b]uyers often buy based on cookies, and cookies are an important part of the valuation of every query."[780] Per-Buyer RPO and Cookie-Based RPO could apply simultaneously to a single impression, in which case the higher of the two estimated floor prices would apply.[781] Overall, an RPO floor applied to fewer than [redacted]% of impressions.[782]

401. RPO only ever increased floor prices. It never set floor prices below the publisher's chosen floor price, even if Google estimated that floor price to be higher than optimal.[783] RPO increased floor prices to the level that maximized the publisher's predicted profits, subject to a constraint that the publisher's predicted match rate did not decrease by more than a certain amount.[784, 785] RPO automatically applied to publisher's Open Auction

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[779] Email from [redacted] to [redacted], "[Launch 132012] Cookie based Dynamic Reserve Price Optimization on AdX - full launch" (Sep. 29, 2015), GOOG-DOJ-15423462, at -462 ("Launch Date 2015-10-05").

[780] "Cookie based Dynamic Reserve Price Optimization (RPO) - mini PRD" (May 1, 2015), GOOG-DOJ-13203511, at -511.

[781] Presentation, "AdX Dynamic Price V2" (May 26, 2015), GOOG-DOJ-14000011, at -012 ("Effective reserve is max of inventory-RPO, cookie-RPO price").

[782] Comms Doc, "Optimized pricing in the Open Auction Comms" (Mar. 23, 2018), GOOG-DOJ-04937154, at -160 ("A: Optimized pricing has no effect on most Open Auction queries - right now it affects the winning price for fewer than [redacted]% of impressions bought by RTB buyers."); "DRS and RPO interaction in Simulation" (Sep. 20, 2016), GOOG-AT-MDL-007375273, at -273 ("Percentage of Impressions" table, "DYNAMIC_RESERVE" row, "Grand Total [...] [redacted]%").

[783] Comms Doc, "Optimized pricing in the Open Auction Comms" (Mar. 23, 2018), GOOG-DOJ-04937154, at -155 ("Optimized pricing can only increase floors from where the publisher has them currently set. It will never lower a floor.").

[784] Email from [redacted] to [redacted], "Re: [drx-pm] LAUNCHED! Dynamic Pricing (RPO) for AdX sellers" (Nov. 12, 2015), GOOG-DOJ-07235914, at -916 ("Pick a reserve price that maximizes predicted revenue, constrained to limit the fraction of bids it eliminates (to preserve match rate).").

[785] At least initially, the match rate was constrained to dropping by no more than [redacted]%. *See* Design Doc, "Cookie Data in Reserve Price Optimization Pipeline" (Mar. 29, 2015), GOOG-DOJ-13200480, at -482 ("We simulate with the default values of the Dynamic Reserve Price Rule Computation parameters. These values are the ones used in

inventory, and there was no option for a publisher to opt out from RPO.[786] While Google had flagged as early as 2014 the possibility that a publisher's floor price might be modified on some impressions,[787] RPO was officially announced to the public on May 12, 2016, as Optimized Pricing.[788]

402. Initially, RPO exempted buyers that submitted at least two bids into the AdX auction.[789] Google engineers discussed this exemption internally as a way to "encourage buyers to declare two bids"[790] in the AdX auction, and it also addressed "concerns" about the interaction of Project Bernanke and RPO.[791] In November 2017, Google engineers noted that the exemption policy was "easy to circumvent by submitting a nominal (1 cent) minimum payment amount with every bid" and, as a result, changed the RPO exemption

the Inventory RPO that runs daily in production. [redacted]") (emphasis omitted).

786 Comms Doc, "Optimized pricing in the Open Auction Comms" (Mar. 23, 2018), GOOG-DOJ-04937154, at -155 ("The publisher does not get any new controls or and opt out and the feature works only in the background.").

787 "Ad Exchange auction model" (Aug. 24, 2014), GOOG-AT-MDL-C-000035250, at -250 ("The Google DoubleClick Ad Exchange may run limited experiments designed to optimize the auction. These experiments may include modifying the standard auction model or mechanics (e.g., a tiered, rather than second price auction); simulating ad calls and auctions; modifying the min CPM set by the publisher for an impression or otherwise adjusting publisher settings; or discounting certain bids submitted by buyers or otherwise modifying the priority of the bids submitted by buyers, in an effort to optimize the auction. Publisher's buyer/advertiser blocks will not be modified.").

788 Email from [redacted] to AdX Buy-Side Global Sales et al., "[ANNOUNCED] Smarter optimizations for DoubleClick Ad Exchange" (May 12, 2016), GOOG-DOJ-04934481, at -481 ("On Thursday afternoon we announced new optimizations for DoubleClick Ad Exchange, Optimized Private Auctions and optimized pricing in the Open Auction (aka RPO).").

789 "AdX Dynamic Price: Sell Side Review fact sheet" (Dec. 2014), GOOG-DOJ-13200158, at -158 ("AdX buyers buying on both AdSense and AdX publishers will be subject to dynamic reserve pricing, subject to a policy [...] to exempt buyers who submit two bids or second price themselves.").

790 "The case for encouraging buyers to declare two bids" (May 11, 2015), GOOG-DOJ-13201465, at -465 ("We can encourage buyers to declare 2 bids per auction for three reasons: 1) In the presence of an effective RPO (reserve price optimization for AdX), AdX is in position to give a discount in pricing a buyer who declares two effective bids and price itself. This strategy will directly incentivises buyers to declare their second highest bid.").

791 "AdX Dynamic Reserve Price: AFC Launch Review Follow up" (Dec. 1, 2014), GOOG-DOJ-13199603, at -603 ("This will address two major concerns: Interaction of Bernanke and dynamic pricing is eliminated, as GDN always submits two bids and thus is exempt.").

policy to exempt bidders that submitted second bids high enough to generate "a certain amount of revenue lift from self-pricing."[792] In particular, Google exempted buyers for which the calculated increase in revenue from the second bid it submitted (compared to submitting only its high bid) was [redacted] times greater than a simulated increase in revenue Google calculated would occur due to RPO (if it submitted only its high bid).[793] Google Ads was exempt from RPO under both policies.[794] Both RPO exemption policies are consistent with RPO being designed in part to respond to auction "thinness" created by buy-side tools' decisions to employ single-bid policies, which (as I discussed above) would otherwise lead to reductions in publisher revenues.

403. In May 2018, Google introduced another version of RPO called Online RPO.[795] Online RPO was motivated by "buyers' bidding behavior on high value re[]marketing cookies," where Google had observed that most impression opportunities for a given cookie arrived within a period of one hour, making it difficult to use the previous day's data to optimize

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[792] Launch Doc, "RPO Exemption Policy V2 Launch Doc" (Nov. 14, 2017), GOOG-DOJ-13212948, at -948.

[793] Launch Doc, "RPO Exemption Policy V2 Launch Doc" (Nov. 14, 2017), GOOG-DOJ-13212948, at -948 ("We run a simulation pipeline where we remove min cpm payments from buyers and calculate the revenue extracted from each buyer for both the case where min cpm payments are on and off. After that we measure the performance over a week worth of simulations and whitelist for RPO exemptions only those buyers that yield a revenue lift of more than [redacted] times the lift of RPO (over both AdX and AdSense), or [redacted]%. [...] At serving time in dynamic price producer we set the RPO reserves to 0 if a buyer belongs to this whitelist.").

[794] "AdX Dynamic Reserve Price: AFC Launch Review Follow up" (Dec. 1, 2014), GOOG-DOJ-13199603, at -603 ("We are exempting bidders (adx 'buyer networks') who submit a second bid to the AdX auction from dynamic pricing which will effectively make all of GDN demand exempt from dynamic pricing."); "Reveal RPO floor to Adwords" (Nov. 11, 2019), GOOG-DOJ-14030931, at -931 ("Previously in second price AdX auctions, Adwords was exempt from RPO floor.").

[795] "2018 Sellside Launches Revenue Evaluation" (Jul. 19, 2019), GOOG-DOJ-13949282, at tab "Q2 2018," row 6 (noting launch date of 5.10.18).

floor prices.[796] Online RPO maintained a sliding window of the [redacted] most recent bids for each buyer-cookie pair in the "high bid range" (meaning that bid requests for the cookie had received bids higher than some threshold) and determined an optimal floor price based on bids in that window.[797] Online RPO operated at the same time as the other RPO models (*i.e.*, Per-Buyer RPO and Cookie-Based RPO), and the maximum of the RPO-computed reserves would apply.[798]

404. Google conducted several experiments to assess the impact of its various RPO models. Experiments from around the time of the launch of Per-Buyer RPO found that it increased Google revenue and publisher payouts on the order of [redacted]% compared to no RPO.[799] Later experiments found that the integration of Cookie-Based RPO increased

[796] Email from [redacted] to [redacted], "UPCOMING LAUNCH - Please review: [Launch 225406] Online Reserve Price Optimization" (Feb. 5, 2018), GOOG-DOJ-14421383, at -383 ("The key motivation of online RPO is to use buyers' bidding behavior on high value re-marketing cookies to set reserve prices. While analyzing bidding patterns on cookies, we observed that most queries for a given cookie arrive within a one hour interval and that there is little overlap between the set of cookies for which queries are received across successive days. In other words requests for the same cookie are highly localized in time making it hard to train a model based on historical data.").

[797] Launch Doc, "Online Reserve Price Optimization Launch Doc" (Sep. 14, 2017), GOOG-DOJ-13211589, at -589 ("Online prediction is accomplished by maintaining a sliding window of the N (current[ly] set to [redacted] most recent bids for each buyer-cookie pair in the high bid range [redacted]) and then applying a prediction function on the set of bids in this window in order to determine per-buyer reserve prices for the query at hand.").

[798] Launch Doc, "Online Reserve Price Optimization Launch Doc" (Sep. 14, 2017), GOOG-DOJ-13211589, at -590 ("The maximum of all reserves including those computed via other RPO models is then applied to the buyer's new bid in the auction.").

[799] Email from [redacted] to [redacted], "[Launch 124105] Per-buyer dynamic reserve price optimization on AdX - full launch [redacted] annual revenue from RTB buyers)" (Nov. 13, 2014), GOOG-DOJ-15419945, at -945 ("Experiments show [redacted] revenue for AdX buyers on AdX pubs and [redacted] for AdX buyers on AdSense pubs. Revenue impact on GDN is neutral."); "AdX Dynamic Price: Sell Side Review fact sheet" (Dec. 2014), GOOG-DOJ-13200158, at -158 ("Based on simulations and live experiments, AdX Dynamic Price increases revenue from AdX buyers (RTB + Static) by about [redacted]. GDN revenue and ROI is largely unaffected due to it being exempt. Benefit to publishers. Publishers benefit from this feature by earning increased revenue from AdX. In aggregate, revenue of AdX publishers increases by [redacted], and revenue for AdSense publishers increases by [redacted]%, for a network-wide increase of [redacted]%."); Presentation, "AdX Dynamic Price" (Dec. 11, 2014), GOOG-DOJ-13199910, at -930 ("AdX pubs [...] Total [redacted] (with GDN opt out").

revenues further: on the order of [redacted]% compared to no RPO.[800] The addition of Online RPO was estimated to further increase revenue by [redacted]% compared to the revenues obtained under the earlier RPO models.[801]

405. RPO was temporarily deactivated when AdX transitioned to the Unified First-Price Auction in September 2019.[802] Google redesigned RPO for application in the Unified First-Price Auction, including modifications to ensure that the same floor price was applied to each buyer within an auction (including Google Ads).[803] Optimized Pricing for the First-Price Auction was launched in June 2022, and it was enabled by default for all publishers using GAM (but it also included an opt-out for publishers).[804] In April 2022, Google also introduced an option (in beta release) for publishers to allow Google to

[800] Email from [redacted] to [redacted]m, "[Launch 132012] Cookie based Dynamic Reserve Price Optimization on AdX - full launch" (Sep. 29, 2015), GOOG-DOJ-15423462, at -462 [redacted]).

[801] Launch Doc, "Online Reserve Price Optimization Launch Doc" (Sep. 14, 2017), GOOG-DOJ-13211589, at -590 ("The launch candidate increases network-wide revenue by [redacted]%").

[802] "Reveal RPO floor to Adwords" (Nov. 11, 2019), GOOG-DOJ-14030931, at -931 ("Note that since moving to first-price auctions, AdX does not have any RPO floor yet (as of 2019/10/31) except small experiment traffic.").

[803] "Apply Dynamic Reserve Price to DFP Remnant Ads in First Price Auctions" (Jan. 5, 2020), GOOG-DOJ-14029750, at -750 ("And similar to how we are migrating legacy per-buyer publisher floor to unified pricing rules, we are making dynamic reserve price non-personalized, and applying that to both DFP remnant and backfill demand."); "Reveal RPO floor to Adwords" (Nov. 11, 2019), GOOG-DOJ-14030931, at -931 ("Previously in second price AdX auctions, Adwords was exempt from RPO floor [...]. This is no longer the case after AdX moved to first-price auctions. RPO floor applies to all demand in first-price AdX auctions.").

[804] "2022 Google Ad Manager releases archive," Google Ad Manager Help, https://support.google.com/admanager/answer/11586212?hl=en#zippy=%2Cjune-optimize-pricing-video-protections-troubleshooting-for-mcm-google-analytics-integration-webview-api-for-ads-updates-to-bid-rejection-reason ("June 6 Optimize pricing [...] Optimize pricing to reflect inventory's value[:] Optimized pricing increases auction floor prices to more accurately reflect and protect your inventory's value. Optimized pricing is enabled by default, but can be disabled via your network settings.").

automatically optimize the floor prices for slices of inventory in its Unified Pricing Rules (UPR) feature (which I discuss further in Section XII).[805]

D. Responding to Plaintiffs' Allegations

1. Google's Communications About RPO and the AdX Auction Format Were Not Misleading

406. Plaintiffs and their experts object to Google's communications about RPO to advertisers and publishers, with Professor Pathak characterizing RPO as a "secret auction manipulation program[]" that "reduced transparency for [Google's] customers."[806] But all of the Plaintiffs' experts overlook the fact that Google had flagged to its customers as early as 2014 the possibility of an optimization like RPO that modified a publisher's floor prices on some impressions.[807] Moreover, RPO was officially announced to the public on

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[805] "Optimize floor prices in unified pricing rules (Beta)," Google Ad Manager Help, https://support.google.com/admanager/answer/11385824 ("Optimized floor prices (Beta) are available as a pricing option within unified pricing rules, in addition to fixed floor prices and target CPM. [...] You specify a slice of inventory in a unified pricing rule where Google will automatically optimize floor prices."); "2022 Google Ad Manager releases archive," Google Ad Manager Help, https://support.google.com/admanager/answer/11586212?sjid=14339833919693691538-NA#zippy=%2Capril-audience-segment-forecasting-optimize-floors-in-uprs-desktop-anchor-ads-linked-account-changes-mediation-chain-update-view-top-pricing-rules-atp-for-lgpd-update ("April 25 [...] Optimize floors in UPRs").

[806] Expert Report of P. Pathak (Jun. 7, 2024), at ¶ 174 ("Google's secret auction manipulation programs reduced transparency for its customers. Google leveraged its ability to reduce transparency when launching programs such as Bernanke, Dynamic Revenue Sharing (including v1, v2, and tDRS), and Reserve Price Optimization ('RPO')."). *See also* Fourth Amended Complaint ¶ 335 ("With RPO, Google abused advertisers' trust and secretly used their true value bids against them."); Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 283 ("Google concealed vital information from advertisers by concealing RPO."); Expert Report of J. Andrien (Jun. 7, 2024), at ¶ 35 ("Google also impacted advertiser behavior through its second-price auction representation and concealment of RPO.").

[807] "Ad Exchange auction model" (Aug. 24, 2014), GOOG-AT-MDL-C-000035250, at -250 ("The Google DoubleClick Ad Exchange may run limited experiments designed to optimize the auction. These experiments may include modifying the standard auction model or mechanics (e.g., a tiered, rather than second price auction); simulating ad calls and auctions; modifying the min CPM set by the publisher for an impression or otherwise adjusting publisher settings; or discounting certain bids submitted by buyers or otherwise modifying the priority of the bids submitted by buyers, in an effort to optimize the auction. Publisher's buyer/advertiser blocks will not be modified.").

May 12, 2016, roughly a year after the program was launched,[808] so any potential impacts from the alleged "concealment" of RPO would have been short-lived.

407. Plaintiffs allege that RPO misled advertisers because it "meant that the auction did not operate as a sealed second price auction as Google had advertised."[809] This is wrong. As I discuss in Section III.C.3, a second-price auction is the sealed-bid auction process that assigns the impression to the highest bidder for a price equal to the larger of the second-highest bid or the highest applicable floor price, set before bids are received. With or without a program like RPO in place, a second-price auction remains a second-price auction, as noted by Plaintiffs' experts Professors Weinberg and Pathak.[810] RPO never unsealed bids received in an auction to set the floor price for that auction.[811]

[808] Jonathan Bellack, "Smarter optimizations to support a healthier programmatic market," Google Ad Manager (May 12, 2016), https://blog.google/products/admanager/smarter-optimizations-to-suppor/ ("In our experiments to date, we have applied optimized pricing to about 15% of transactions, creating over 5% lift in revenue for publishers using the Open Auction. As we expand our experiments with optimized pricing, we will monitor its performance to ensure advertisers continue to get great ROI."). *See also* Email from [redacted] to [redacted] [redacted]., "[ANNOUNCED] Smarter optimizations for DoubleClick Ad Exchange" (May 12, 2016), GOOG-DOJ-04934481, at -481 ("On Thursday afternoon we announced new optimizations for DoubleClick Ad Exchange, Optimized Private Auctions and optimized pricing in the Open Auction (aka RPO).").

[809] Fourth Amended Complaint ¶ 532. *See also* Expert Report of J. Andrien (Jun. 7, 2024), at ¶ 35 ("Google also impacted advertiser behavior through its second-price auction representation and concealment of RPO. Namely, I understand that Google's representation that it was running a second-price auction encouraged advertisers to bid their true value for impressions, which over time caused later AdX reserve prices to increase, which, in turn, led to a payoff loss for advertisers by decreasing win rates and increasing the average clearing price in later AdX auctions."); Expert Report of J. Chandler (Jun. 7, 2024), at ¶ 348 ("With Reserve Price Optimization (RPO), advertisers believed they were in a standard second-price auction, but Google set artificially high reserve prices to optimize AdX revenue, often higher than the publisher's floor price.").

[810] Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 285 ("Note that each individual auction in isolation is still a second-price auction with reserve [...] .") (describing an example of the operation of RPO); Expert Report of P. Pathak (Jun. 7, 2024), at ¶ 191 ("As a result, even though AdX ran a second-price auction at the time [...] .") (discussing RPO's effects on advertiser bidding behavior).

[811] Comms Doc, "Optimized pricing in the Open Auction Comms" (Mar. 23, 2018), GOOG-DOJ-04937154, at -159 ("[T]he price a buyer pays is not related to the bid in the present auction."), -161 ("[O]nly historical bids are analyzed - we do not use the bids in the auction to set the floor.").

408. Plaintiffs and some of their experts claim that Google's auction is not a "true" second-price auction by noting that a repeated auction process may fail to incentivize bidders to bid their true values.[812] Plaintiffs quote a Google employee who made similar errors: "Doesn't that undermine the whole idea of second price auctions?"[813] While any second-price auction is bidder-truthful—meaning that the bidder cannot increase its payoff *in that auction* by bidding anything other than its value for the impression—it has long been understood (and was noted by Professor Weinberg[814]) that a bidder might gain by untruthful bidding in a *repeated* second-price auction. For example, I wrote in a 2006 paper (referencing a 1990 paper by Rothkopf, Teisberg and Kahn[815]) that "[b]idders [in a second-price auction] may rationally be reluctant to report their true values, fearing that

[812] *See* Fourth Amended Complaint ¶ 346 ("All the while, Google continued to lead publishers and advertisers to believe that AdX operated a second-price auction, inducing advertisers to submit a sealed bid reflecting their true value."), ¶ 330 ("Consequently, when bidding into AdX and revealing their true value, advertisers relied on Google's representations that AdX was truly a sealed second-price auction."), ¶ 533 ("[...] because of RPO, Google's AdX auctions were not conducted as a true sealed second price auction as Google advertised. Rather with RPO, winning advertisers did not pay the true second price in an auction. Instead, they paid an artificially inflated price floor which Google set using advertiser's own bidding information against them. Second, Google encouraged advertisers to provide their true value in connection with what they thought was a sealed second price auction. The benefit of an advertiser bidding their true value into a second price auction is only realized when the auction is won, and the winner pays a second price below their true value bid. Instead, Google failed to disclose that it would use historical bidding information to artificially drive up the second price, by increasing publisher's preset price floor and replacing it with an artificially inflated floor derived from advertiser's historical bidding information."); Expert Report of J. Andrien (Jun. 7, 2024), at ¶ 35 ("Google also impacted advertiser behavior through its second-price auction representation and concealment of RPO. Namely, I understand that Google's representation that it was running a second-price auction encouraged advertisers to bid their true value for impressions, which over time caused later AdX reserve prices to increase, which, in turn, led to a payoff loss for advertisers by decreasing win rates and increasing the average clearing price in later AdX auctions."); Expert Report of J. Chandler (Jun. 7, 2024), at ¶ 348 ("With Reserve Price Optimization (RPO), advertisers believed they were in a standard second-price auction, but Google set artificially high reserve prices to optimize AdX revenue, often higher than the publisher's floor price.").

[813] Fourth Amended Complaint ¶¶ 347, 537; Email from M. Loubser to D. Bradstock, "Re: [drx-prm] Re: SBS Australia meeting notes - April 30th" (May 1, 2015), GOOG-TEX-00537828, at -829.

[814] Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 52 ("Truthfulness only holds when viewing this auction in isolation, it does not necessarily hold when considering a series of auctions [...].").

[815] Rothkopf, M.H., Teisberg, T.J., & Kahn, E.P. (1990). Why are Vickrey auctions rare? *Journal of Political Economy*, *98*(1), 94-109.

the information they reveal will later be used against them."[816] This does not change a second-price auction into something else, but highlights that the possibility of learning is an *unavoidable* complication when auctions are run repeatedly and sellers learn from experience how to set price floors. Even in that case, however, using a second-price auction format "minimizes the need to 'game' the system," as noted by a Google employee (as quoted by Plaintiffs).[817] In repeated second-price auctions, the possibility of learning is the *only* reason for a bidder to adjust its bids away from its value for an impression. That possibility of bid adjustment in the repeated second-price auction context does not change the basic fact that each individual auction is second-price.

409. Plaintiffs allege that Google was "misleading[]" when it claimed that RPO "helps advertisers by increasing the amount of inventory available for purchase programmatically."[818] But encouraging publishers to make more inventory available to programmatic sales is a likely result of *any* program that increases publisher yield per impression. This is a simple consequence of the well-known law of supply: all else equal, an increase in the price received by a seller increases the quantity supplied.[819]

410. Plaintiffs allege that—prior to the public announcement of RPO in May 2016—Google "continued to mislead publishers by encouraging them to adjust Google exchange floors in their publisher ad server [...] leading them to believe that they could control outcomes

[816] Ausubel, L.M., & Milgrom, P. (2006). The lovely but lonely Vickrey auction. In P. Cramton, Y. Shoham & R. Steinberg (Eds.), *Combinatorial Auctions* (pp. 17-40). MIT Press.

[817] Fourth Amended Complaint ¶ 531 (quoting AdExchanger, "Google's Scott Spencer On DoubleClick Ad Exchange Auction And Data Management," AdExchanger (Feb. 9, 2010), https://www.adexchanger.com/ad-exchange-news/googles-scott-spencer-on-doubleclick-ad-exchange-auction-and-data-management/.

[818] Fourth Amended Complaint ¶ 345.

[819] Mas-Colell, A., Whinston, M.D., & Green, J.R. (1995). *Microeconomic theory.* Oxford University Press, at 138.

and optimize yield through floors."[820] But publishers could still set effective floor prices when RPO was in place: the publisher would never receive a payment lower than the floor price it set. This means that publishers could always effect a floor price in AdX higher than the RPO floor. Even before RPO was introduced, EDA or the value CPMs of remnant line items could increase the effective floor prices for advertisers to be above the floor prices set by publishers. Moreover, RPO was a program with *very large* benefits to publishers: Per-Buyer RPO and Cookie-Based RPO together increased publisher revenues on the order of [redacted]%, and Online RPO increased publisher revenues even further.[821]

2. Publishers Benefited From RPO

411. Professor Weinberg claims that there are "reasons why some publishers ***might*** prefer outcomes without RPO than with RPO."[822] To support these claims, he provides examples

[820] Fourth Amended Complaint ¶ 342.

[821] Email from [redacted] to [redacted]m, "[Launch 124105] Per-buyer dynamic reserve price optimization on AdX - full launch [redacted] annual revenue from RTB buyers)" (Nov. 13, 2014), GOOG-DOJ-15419945, at -945 ("Experiments show [redacted]% revenue for AdX buyers on AdX pubs and [redacted]% for AdX buyers on AdSense pubs. Revenue impact on GDN [redacted]."); "AdX Dynamic Price: Sell Side Review fact sheet" (Dec. 2014), GOOG-DOJ-13200158, at -158 ("[E]xperiments, AdX Dynamic Price increases revenue from AdX buyers (RTB + Static) by about [redacted]%. GDN revenue and ROI is largely unaffected due to it being exempt. Benefit to publishers. Publishers benefit from this feature by earning increased revenue from AdX. In aggregate, revenue of AdX publishers increases by [redacted] and revenue for AdSense publishers increases by [redacted]%, for a network-wide increase of [redacted]%."); Presentation, "AdX Dynamic Price" (Dec. 11, 2014), GOOG-DOJ-13199910, at -930 ("AdX pubs [...] Total [redacted]% (with GDN opt out)"; Email from [redacted] to [redacted], "[Launch 132012] Cookie based Dynamic Reserve Price Optimization on AdX - full launch" (Sep. 29, 2015), GOOG-DOJ-15423462, at -462 ("We've previously experimented [with per-buyer RPO]. Experiments show [redacted]% revenue from AdX buyers across AdX and AdSense publishers incremental to [per-buyer RPO]."); Email from [redacted] to [redacted], "Re: RPO rollout schedule" (Sep. 21, 2015), GOOG-DOJ-15423317, at -319 ("The cookie pricing model alone generates about [redacted]% increase in adx buyer revenue compared to no dynamic pricing. When used together with the primary ('inventory') model, it generates [redacted]% revenue increase on top of the primary model [redacted]% total increase)."); Presentation, "AdX Dynamic Price V2" (May 26, 2015), GOOG-DOJ-14000011, at-012 ("Inventory RPO impact: [redacted]% on AdX buyers [...] Cookie RPO impact: about the same (and less than expected from sim) [...] Combined impact: [redacted]% (almost additive) on adx buyers"); Launch Doc, "Online Reserve Price Optimization Launch Doc" (Sep. 14, 2017), GOOG-DOJ-13211589, at -590 ("The launch candidate increases network-wide revenue by [redacted]%").

[822] Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 280 (emphasis added).

of publisher objectives that he claims are not supported by RPO, including publishers who are interested in "maximiz[ing] the number of sold ads (as opposed to maximizing their revenue)"[823] and publishers who "prefer[] to trust their own optimization over Google's."[824] But RPO was designed to support publishers "to earn the most money possible, with the least complexity,"[825] and the simplicity of its automation together with the significant increases in publisher revenues that Google measured in its RPO experiments (discussed in Paragraph 404 above) show that the program was very successful in achieving those goals. None of the Plaintiffs' experts provide actual evidence of publishers with the preferences that they speculate "might" exist or point to examples of publishers claiming to be harmed by Google's RPO program. Nor am I aware of any such evidence.

3. Publishers and Advertisers Were Not Harmed By "Concealment" of RPO

412. Plaintiffs and their experts allege that advertisers and publishers were harmed by the "concealment" of RPO.[826] Yet, as explained in Section II.B.3 of this report, processes for

[823] Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 280.

[824] Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 279.

[825] Comms Doc, "Optimized pricing in the Open Auction Comms" (Mar. 23, 2018), GOOG-DOJ-04937154, at -154 ("Our goal has always been to help publishers thrive and create sustainable businesses with advertising: to earn the most money possible, with the least complexity, all while providing users the best experience.").

[826] *See, e.g.*, Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 272 ("The negative effects of RPO to advertiser payoff, and possibly some publishers' revenues, at least partially stem from Google's concealment of the conduct."); Expert Report of P. Pathak (Jun. 7, 2024), at ¶ 191 ("As a result, by concealing RPO, Google interfered with the publishers' revenue maximization [...] As a result, both the publishers and the advertisers could act accordingly if they knew RPO was in effect. This potentially reduces their revenue or payoff compared to what they could have been."); Expert Report of J. Chandler (Jun. 7, 2024), at ¶ 360 ("It is my opinion that those undisclosed Google rule changes were contrary to the expectations of the auction participants and made it impossible for auction participants and competing exchanges to understand the rules that governed and applied to auctions run by Google, skewing decision-making and outcomes.") (discussing RPO, DRS v1, and Bernanke); Expert Report of J. Andrien at ¶¶ 34-35 ("For example, by concealing RPO, Google prevented publishers from effectively optimizing revenue, [...] Google also impacted advertiser behavior through its second-price auction representation and concealment of RPO.").

setting reserve prices, like those for computing bids, are routinely kept secret to avoid other participants exploiting the details of those processes to their own advantage, at the expense of the publisher. The concealment of a program like RPO serves the publisher's interests and should be expected by advertisers.

413. Professor Weinberg argues that a lack of transparency about the functioning of RPO "prevented the publishers from effectively optimizing their revenues,"[827] and Professor Pathak echoes these claims, alleging that "since the program was not announced to publishers, publishers would not be able to maximize their revenues under the scheme."[828] In reality, RPO was a service that helped publishers that had set some floor prices too low by raising those floor prices to increase their revenues, and Google experiments found that RPO had very large benefits for publishers. RPO did not prevent publishers from running experiments that could identify further improvements or even revenue-maximizing floor prices. Also, if a publisher had chosen the revenue-maximizing floor price for an impression, RPO would make *no change* to the floor price applied for that publisher. These same observations undermine Professor Weinberg's additional claim that "even after RPO [was] disclosed, publishers would still face challenges setting optimal reserves under RPO."[829]

414. Professor Weinberg alleges that "[a]dvertisers would change their bidding behavior had Google revealed RPO,"[830] and Professor Pathak agrees, alleging that "had they known

[827] Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 279.

[828] Expert Report of P. Pathak (Jun. 7, 2024), at ¶ 190.

[829] Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 279.

[830] Expert Report of M. Weinberg (Jun. 7, 2024), at Section IX.B.1.

[about RPO], the advertisers might have wanted to shade their bids."[831] But this incentive is not a result of programs like RPO or the many similar programs employed by non-Google supply-side intermediaries.[832] As noted above, in *any* auction setting involving repeated interactions, a buyer or seller needs to account for the possibility that another auction participant might learn from its past behavior and use that information in future interactions.[833] Even before the introduction of Optimized Pricing in April 2015, publishers were already adjusting price floors based on historical bids,[834] which suggests that RPO was automating an optimization function that publishers were already doing themselves. Plaintiffs' experts provide no evidence that the disclosure of the program in 2016 led to any change in bidder behavior (as would be expected under their theory), so

[831] Expert Report of P. Pathak (Jun. 7, 2024), at ¶ 191. *See also* Fourth Amended Complaint ¶¶ 532-33 ("Instead, advertisers were forced to pay significantly more for an ad they otherwise would have paid in the absence of RPO. [...] Had advertisers known that Google was manipulating publisher floors in this manner, they would have engaged in alternative bid strategies that did not disclose their true value for each impression.").

[832] [redacted] Rubicon Project, "Maintaining the Equilibrium: How Dynamic Price Floors Preserve the Integrity of the Automated Advertising Ecosystem" (2014), GOOG-AT-MDL-011234683, at -696 ("Rubicon Project gives sellers the opportunity to employ a sophisticated Dynamic Price Floor algorithm which works above a seller's hard floors."); [redacted]

[833] This is sometimes known as the "ratchet effect" in economic theory. *See* Freixas, X., Guesnerie, R., & Tirole, J. (1985). Planning under incomplete information and the ratchet effect. *The Review of Economic Studies*, *52*(2), 173-91; Bergemann, D., & Välimäki, J. (2019). Dynamic mechanism design: An introduction. *Journal of Economic Literature*, *57*(2), 235-74.

[834] Comms Doc, "Optimized pricing in the Open Auction Comms" (Mar. 23, 2018), GOOG-DOJ-04937154, at -155 ("Optimized pricing in the Open Auction automates the post-auction analysis and floor price updates that publishers are already doing and takes it a step further.").

the suggestion that the alleged concealment of RPO affected advertiser behavior is mere speculation.

XII. SELL-SIDE DYNAMIC REVENUE SHARING: INCREASING MATCH RATES AND PUBLISHER REVENUES

A. Overview

415. Dynamic Revenue Sharing (DRS) was a sell-side feature on AdX "that increases publisher and Google revenue by dynamically changing the AdX sell-side revenue share so that more auctions end with a winning buyer."[835] Although DRS evolved over time, each version involved reducing AdX's revenue share applied to some individual impressions to allow publishers to sell more impressions and AdX bidders to win more impressions. While DRS varied AdX's revenue share impression-by-impression, the average revenue share for each publisher remained close to and no lower than the contracted level throughout all three versions.[836] By maintaining or increasing the average revenue share received by the publisher, DRS could increase Google's profits only when it also increased the total revenues it paid to publishers.

416. Plaintiffs and their experts allege that "[a]lthough DRS could increase the volume transacted by publishers, it could also harm them due to the opportunity cost of clearing a bid at a lower price."[837] Although it is correct that one of the key benefits of DRS was an increased volume of transactions cleared, in their analysis of harms to publishers, Plaintiffs and their experts fail to account correctly for strategic adjustments: in the

[835] Comms Doc, "Dynamic Revenue Share" (Jan. 29, 2020), GOOG-DOJ-15130321, at -321.

[836] The revenue share was closer to [redacted] during DRS v1. *See* Email from [redacted] "LAUNCHED! AdX Dynamic Revenue Share (DRS)" (Sep. 2, 2015), GOOG-AT-MDL-B-001391461, at -462 ("AdX margin: [redacted]"); Comms Doc, "Dynamic Revenue Share" (Jan. 29, 2020), GOOG-DOJ-15130321, at -324 ("DRS v2 […] maintain[s] a Google share of [redacted]); Design Doc, "Truthful DRS Design Doc" (Mar. 24, 2017), GOOG-DOJ-13227256, at -261 ("keep the average AdX revshare at the contracted value [redacted].").

[837] Expert Report of J. Gans (Jun. 7, 2024), at ¶ 839. *See also* Fourth Amended Complaint ¶ 325.

presence of DRS, publishers would be incentivized to increase floor prices. After accounting correctly for those adjustments, my analysis shows that DRS would likely increase total publisher revenues. These findings are consistent with Google's internal experiments at the time DRS was introduced.[838]

417. Plaintiffs' experts claim that buyers and publishers were unable to optimize their bids and floor prices because Google "misrepresent[ed] the sealed second-price auction."[839] This claim is incorrect for two reasons. *First*, starting from at least August 2015—before the launch of DRS v1—Google publicly disclosed on the AdX Help Center page that AdX could adjust its revenue share on individual impressions.[840] *Second*, buyers and publishers

[838] Presentation, "Overall Pub Yield with DRS(v2)" (Apr. 7, 2016), GOOG-DOJ-13235100, at -101 to -102 states a [redacted] in total publisher revenues when comparing pre-DRS to DRS v2 [redacted] in publisher revenue"; "that is the lift of DRS v2 (half-way with buy/pub side recollection) compared with no-DRS, since all the numbers in the deck are DRSv2 vs no-DRS"); Email from [redacted] to [redacted] al, "LAUNCHED! AdX Dynamic Revenue Share (DRS)" (Sep. 2, 2015), GOOG-AT-MDL-B-001391461, at -462 states an [redacted] i[redacted] publisher revenues from AdX when comparing pre-DRS to DRS v1 ("AdX publisher payout: [redacted]").

[839] Expert Report of J. Gans (Jun. 7, 2024), at ¶ 855. *See also* Expert Report of P. Pathak (Jun. 7, 2024), at ¶ 188; Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 220.

[840] For the Help Center page before the launch of DRS v1, see Help Center Page, "Ad Exchange auction model" (Aug. 4, 2015), GOOG-AT-MDL-C-000035251, at -251 ("DoubleClick Ad Exchange determines the winning bidder based on the highest net bid submitted. Note that the net bid reflects any adjustments Ad Exchange may, at its discretion, have made to the bid submitted by the buyer for the purpose of optimizing the auction. [...] In some cases, the auction may close at a price lower than the reserve price applied, due to auction optimizations. Sellers are paid the Ad Exchange closing price, net of Google's revenue share, but will receive, subject to the terms governing their use of Ad Exchange, no less than the min CPM applied to the auction."). For the Help Center page before the launch of DRS v2, see Help Center Page, "Ad Exchange auction model" (Jun. 14, 2016), GOOG-AT-MDL-C-000035252, at -252 ("DoubleClick Ad Exchange determines the winning bidder based on the highest net bid submitted. Note that the net bid reflects any adjustments Ad Exchange may, at its discretion, have made to the bid submitted by the buyer for the purpose of optimizing the auction. [...] To optimize the auction, Google may choose to close an auction at a price lower than the reserve price that would have otherwise been applied. In such cases, the winning buyer may pay a price below the reserve and therefore receive a discount on its bid. A buyer that has received discount(s) on its bid(s) may face higher reserve prices in subsequent transactions to offset such discount(s). Subject to the terms governing their use of Ad Exchange, sellers are paid the Ad Exchange closing price, net of Google's revenue share, but will receive no less than the min CPM they specified for the auction. Unless the 'per-query revenue share' setting is enabled by a Seller, auction optimizations may result in an auction closing at a price lower than the reserve price that would have otherwise been applied. Because the Seller will always be paid at least its specified min CPM, the Seller may receive more than its contracted revenue share on the transaction. In subsequent transactions, the Seller's revenue share may then be reduced to offset the prior earnings in excess of the contracted revenue share, but the Seller will always receive at least its contracted revenue share across all its Ad Exchange transactions in a given month.").

can experiment to improve their own outcomes regardless of what information they have about the auction.

418. Plaintiffs argue that "DRS was exclusionary and inflicted significant harm on competition in the exchange market [...] Only Google's exchange could set its take rate on an impression-basis after peeking at all of its rival's net bids."[841] Plaintiffs' experts similarly claim that "DRS is most harmful to competition"[842] and that DRS "increases Google's win rate and revenue and further decreases the win rate and revenue of other exchanges."[843] In fact, DRS applied predominantly to allow the sale of impressions where the publisher-set floor prices were too high to be met, rather than ones for which floor prices were determined by header bidding.[844] "Peeking ahead at other exchanges' net bids"[845] was irrelevant in those cases, and DRS was output-expanding, allowing the sale of impressions that may not otherwise have been allocated[846] and increasing AdX's win rate and publisher revenues without affecting the win rates or revenues of those other exchanges. In other cases, which were fewer in number, DRS allowed the publisher to increase the price it received for an impression above its best offer from header bidding (via the so-called "last look"). DRS was an improvement in AdX's product offering that

[841] Fourth Amended Complaint ¶ 330.

[842] Expert Report of J. Gans (Jun. 7, 2024), at ¶ 807.

[843] Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 224.

[844] *See* "DRS and RPO interaction in Simulation" (Sep. 20, 2016), GOOG-AT-MDL-007375273, at -273. Internal Google experiments show that, of the impressions on which DRS lowered the AdX revenue share, [redacted] occurred when the payment was determined by a third-party bid. By contrast, [redacted] occurred when the payment was determined by a publisher floor price. *See id. See also* Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 32 ("In most cases when DRS applied, the reserve price was set by the publisher-set floor price.").

[845] Fourth Amended Complaint ¶ 328.

[846] Or would have been allocated to remnant line items that paid less than the publisher-set floor price.

increased payments to publishers, reduced the number of unsold impressions (expanding output), and increased the total value of impressions won by AdX advertisers.

B. How Dynamically Adjusting Revenue Shares By Impression Can Create Value By Selling More Impressions and Increasing Publisher Revenues

419. An intermediary, such as AdX, with more accurate predictions than the seller about a buyer's value can sell more impressions and increase seller revenues (along with its own profits) by dynamically adjusting the revenue share it applies to individual impressions. Because the minimum bid required to win an impression depends on both the floor price *and* the revenue share applied to the impression, AdX could change the probability that an impression sold by changing its revenue share on an impression. The goal of increasing publisher revenue and enabling the sale of additional impressions is consistent with the description of the objectives for DRS in Google's internal documents: "DRS is an optimization feature that increases publisher and Google revenue by dynamically changing the AdX sell-side revenue share so that more auctions end with a winning buyer."[847]

420. Here is one example that illustrates the possible benefits of a program like DRS. Suppose a publisher is selling impressions to a potential buyer through an intermediary that charges a 20% revenue share. The buyer's value (in CPM) is $1.00 for 10% of impressions, $1.25 for 80% of impressions, and $1.50 for the remaining 10% of impressions, but the publisher does not know for any given impression what the buyer's value will be.[848]

[847] Comms Doc, "Dynamic Revenue Share" (Jan. 29, 2020), GOOG-DOJ-15130321, at -321.

[848] After applying the 20% revenue share, the net CPMs are $0.80, $1.00, and $1.20, respectively.

421. First, I calculate the publisher's maximum revenues in the absence of a program like DRS. In that case, the publisher can calculate, for each possible floor price, the probability that the impression will sell and use that information to determine the floor price that maximizes its revenue. In the example, if the publisher chooses a floor price of $1, after accounting for the intermediary's 20% revenue share, the buyer must bid at least $1.25 to win the impression, and in that case, the impression sells 90% of the time, leading to an expected revenue of 90¢ for the publisher. This is more than it can expect to earn with any other floor price.[849]

422. Now, suppose that the intermediary can perfectly predict the values of the advertiser and use that information to increase publisher revenues, while maintaining its 20% revenue share on average. To maximize the publisher's revenue, the intermediary can adjust its revenue share on a per-impression basis. When it predicts that the buyer's CPM is $1, it can set its revenue share at 0%, allowing the impression to sell to the buyer at the publisher's floor price of $1, and when it predicts the buyer has a CPM of $1.50, it can set its revenue share at 33%, selling the impression to the buyer at a price of $1.50 and passing the net revenue of $1 on to the publisher. The result is that the advertiser is able to purchase more impressions (the percentage of impressions sold rises from 90% to 100%), the publisher increases its revenues (from $0.90 to $1 on average per impression), and the intermediary, which still has an average revenue share of 20%, also increases its profits.

[849] If the publisher's floor price is 80¢ (leading to a pre revenue share floor price for buyers of $1), the impression sells 100% of the time, giving the publisher expected revenue of 80¢. If the publisher's floor price is $1.20 (leading to a pre revenue share floor price for buyers of $1.50), the impression sells only 10% of the time, giving the publisher expected revenues of 12¢. Any higher floor price for the publisher never sells the impression and any lower floor price leads to lower revenues.

423. This example is not contrived. It shows one way in which a better-informed intermediary can dynamically set its per-impression revenue shares to help a publisher sell more impressions, increasing its revenue. Similar effects can be achieved for very general distributions of advertiser values and different qualities of information available to the intermediary.[850]

424. This example is not intended to illustrate the exact operation of any one version of DRS, which used more complicated rules to determine revenue shares than that described in the example. The key properties that the example and DRS have in common is that when DRS observed or predicted that the buyer had a low valuation, it would lower the AdX revenue share on those impressions to allow additional sales, and that, in some versions, it would raise its revenue share on other impressions to maintain a fixed average AdX revenue share. The details of DRS evolved through three versions over time, and the way Google collected payment for its services also varied, but just as in the example, Google designed DRS to increase publisher revenues and the quantity of impressions sold, thereby raising its own revenue.[851]

C. DRS Increased Match Rates and Publisher Revenues and Evolved to Simplify Bidding for Advertisers

425. Google recognized the potential for a program like DRS to increase its profits while helping publishers sell more impressions and increasing their revenues, but it took time to

[850] This example is inspired by Bergemann, D., Brooks, B., and Morris, S. (2015). The limits of price discrimination. *American Economic Review*, *105*(3), 921-57. It deviates from their exact model, in which the better-informed party sets the (floor) price rather than the revenue share.

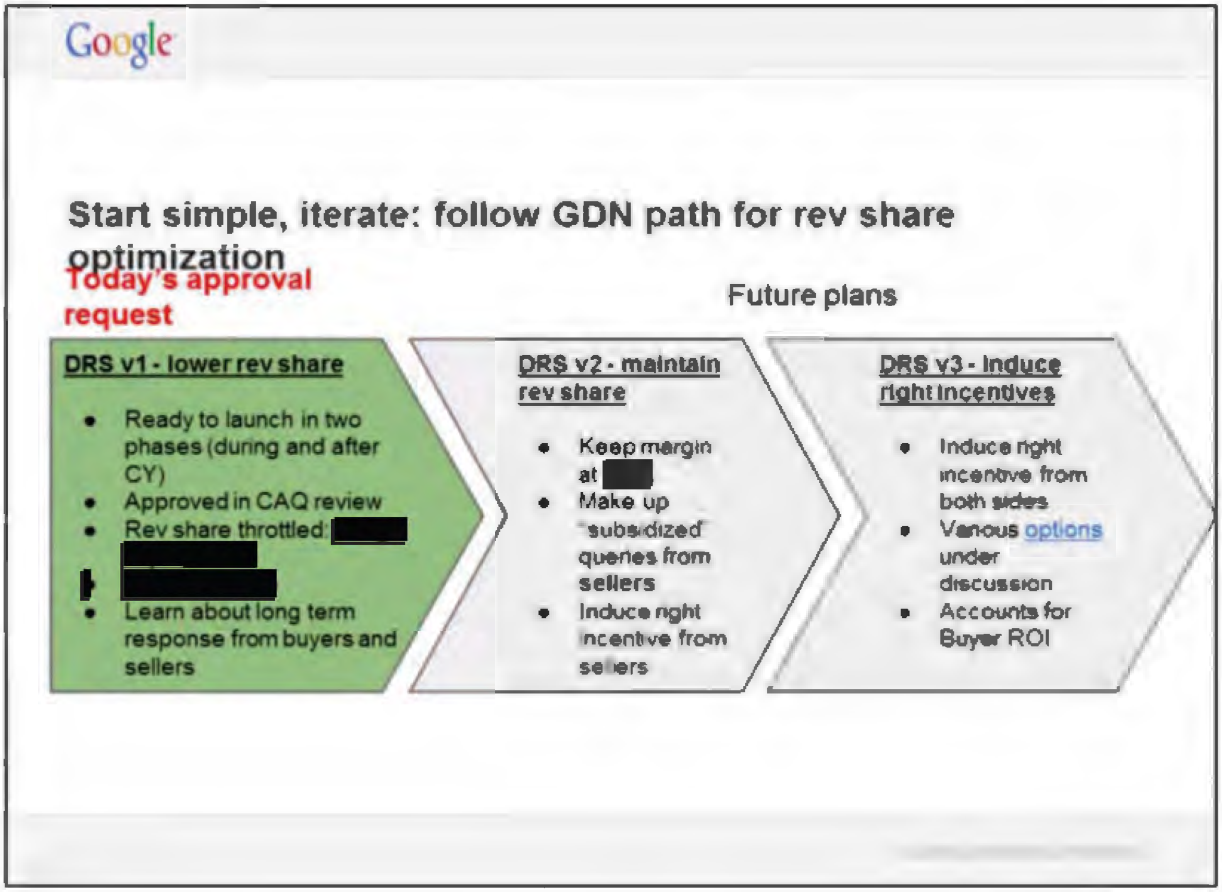
[851] *See* Comms Doc, "Dynamic Revenue Share" (Jan. 29, 2020), GOOG-DOJ-15130321, at -321 ("DRS is an optimization feature that increases publisher and Google revenue by dynamically changing the AdX sell-side revenue share so that more auctions end with a winning buyer.").

engineer a program that did so effectively while maintaining its fixed average revenue share and simple bidding for advertisers. As shown in Figure 13, an excerpt from Google's launch documents for DRS v1, Google planned and implemented a gradual introduction of DRS, testing elements of its design, while monitoring the responses of advertisers and publishers and tracking the impacts of the program on publisher and advertiser outcomes.[852] Google launched DRS v1 expecting to "learn from a simple version and see responses."[853]

[852] *See* Presentation, "AdX DRS v1 launch review" (Feb. 13, 2015), GOOG-DOJ-13199952, at -958, -960 ("Holdback plan to assess long term buyer and seller response").

[853] Presentation, "AdX DRS v1 launch review" (Feb. 13, 2015), GOOG-DOJ-13199952, at -956.

Figure 13: Google's planned evolution of DRS[854]



1. DRS v1 Lowered Per-Impression Revenue Shares to Sell More Impressions

426. In DRS v1, launched in August 2015, AdX made only one change to its auction rules: it reduced its revenue share on some impressions to allow more impressions to be sold.[855] Under DRS v1, AdX would first determine for each impression if the highest bid it had

[854] Presentation, "AdX DRS v1 launch review" (Feb. 13, 2015), GOOG-DOJ-13199952, at -958.

[855] Email from [redacted], "LAUNCHED! AdX Dynamic Revenue Share (DRS)" (Sep. 2, 2015), GOOG-AT-MDL-B-001391461, at -461 ("DRS clears queries when the highest bid is above the publisher floor, but not quite enough above the floor to cover the 20% AdX revenue share. In these cases we lower the revenue share per query as needed to increase transaction volume and increase match rate."); "AdX dynamic sell-side rev share (DRS v1) - project description / mini PRD" (Aug. 2014), GOOG-DOJ-03619484, at -484 ("Reduce the 20% rev share when there is no winner at 20% and an opportunity to find a winner with a reasonable, lower rev share").

received was in the "dynamic region," meaning that the bid would not clear the floor price if AdX charged its standard revenue share on that impression, but the bid would clear the floor price if AdX selected a 0% share.[856] On an impression for which the highest bid fell in this dynamic region, AdX would sometimes reduce its revenue share on that impression as needed to allow the bid to clear the floor price. AdX did not reduce its revenue share on each such impression: instead it "throttled" the application of DRS, meaning that it applied it probabilistically, adjusting the probability it applied DRS over time to ensure that the average AdX revenue share on impressions sold by each publisher and to each advertiser both did not drop significantly below the contracted AdX revenue share (for example, for publishers who had contracted an AdX revenue share of 20%, AdX throttled DRS v1 to maintain an average revenue share of at least 19%).[857]

427. Figure 14 displays an example of how DRS v1 could increase publisher revenues and the quantity of impressions transacted. In this example, the publisher sets a floor price of $1.00. Without DRS, AdX collects its contracted revenue share on each impression (in

[856] In its initial design of DRS, Google was agnostic about the source of the floor price that AdX faced. It could have been a floor price set by the publisher, a value CPM from a remnant line item (including header bidding line items), or a floor price GAM had calculated under its Reserve Price Optimization (RPO) program. DRS treated these floor prices the same way, without distinguishing their source. In July 2017, Google updated the DRS algorithm to exclude RPO floor prices, effectively ensuring that a fixed revenue share was applied to impressions for which the floor price was determined by RPO. *See* Launch Details Spreadsheet, Launch 193573 (Sep. 1, 2023), GOOG-AT-MDL-009644409, at cell B2 ("Disable dynamic revenue sharing for RPO prices").

[857] Email from M. Loubser to drx-pm@google.com et al., "LAUNCHED! AdX Dynamic Revenue Share (DRS)" (Sep. 2, 2015), GOOG-AT-MDL-B-001391461, at -461 ("DRS clears queries when the highest bid is above the publisher floor, but not quite enough above the floor to cover the 20% AdX revenue share. In these cases we lower the revenue share per query as needed to increase transaction volume and increase match rate. We limit how often we reduce the margin to maintain a >=19% average margin[.]"); Presentation, "Dynamic Sell-Side Revshare[:] GDN/DRX Summit 2015" (Nov. 2, 2015), GOOG-DOJ-13202659, at -670 ("Probabilistically throttle DRS[:] For an incoming query, we flip a coin to throttle queries (publisher) or winner (advertiser) when AdX margin is squeezed below a predefined threshold. […] Adjust throttling probabilities based on the difference in measured margin and pre-defined threshold."); Presentation, "AdX DRS v1 launch review" (Feb. 13, 2015), GOOG-DOJ-13199952, at -954 ("Buyers throttled based on whether query will clear using DRS, then checking buyer throttling table for winning buyer[;] Sellers throttled based on lookup of pub throttling state by query (query identifies pub)").

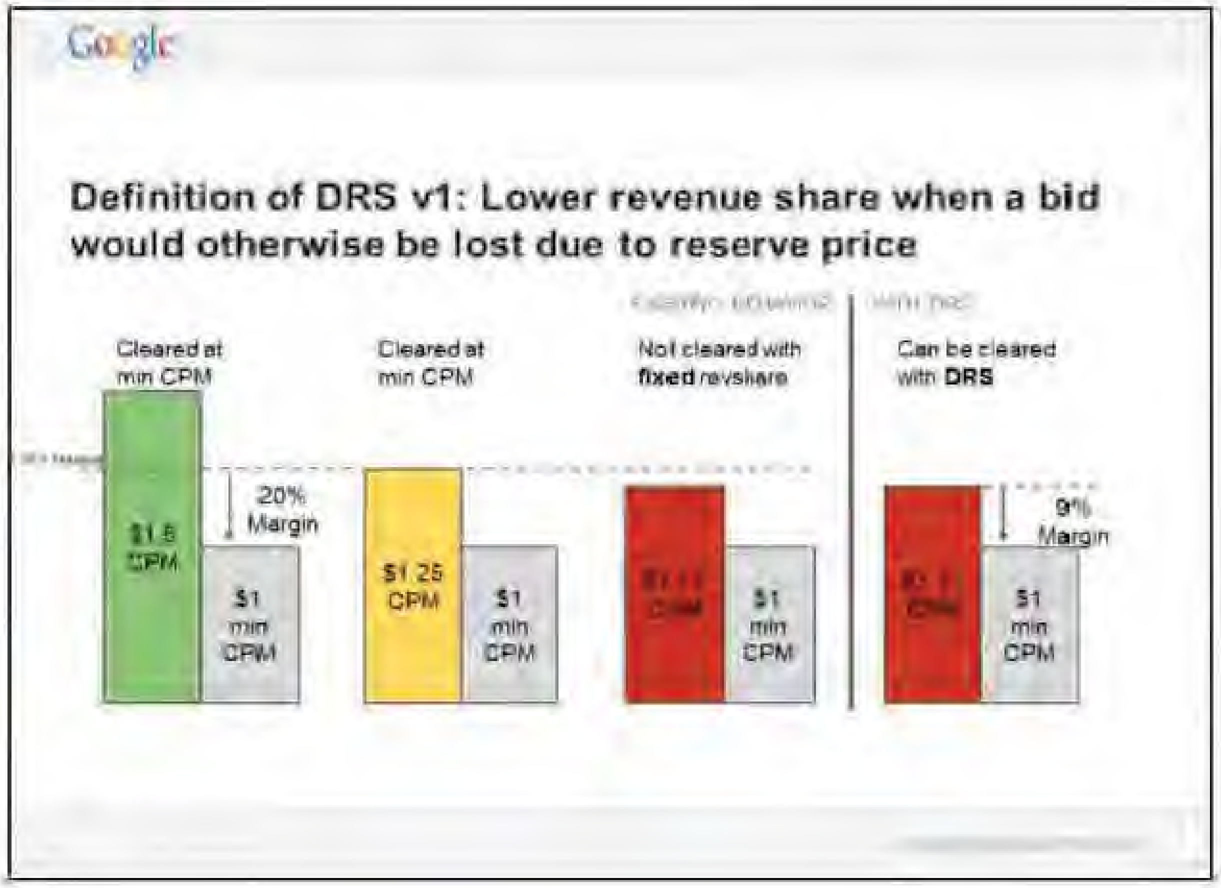
this example, 20%), which means that the impression can only sell if the advertiser bids at least $1.25.[858] This could leave revenue on the table for the publisher: if the advertiser bids $1.11, it does not win the impression, even though it is willing to pay more than the publisher's floor price for the impression. Under DRS v1, AdX would sometimes reduce its revenue share on the impression as needed to allow the impression to sell. If DRS v1 was applied to the same impression with a floor price of $1 and bid of $1.11, AdX would reduce its revenue share to 10%, allowing the bidder to win the impression while paying its bid of $1.11, and passing on $1.00 of that to the publisher, leaving 11¢ in revenue for AdX (equivalent to a 10% revenue share on that impression).[859, 860]

[858] To calculate the floor price facing the advertiser, divide the publisher's floor price by the publisher's revenue share (which is one minus the AdX revenue share). In this case, this calculation obtains $1.00/(1-0.2)=$1.25.

[859] Note that Figure 14—reproduced from an internal Google document—incorrectly calculates a 9% revenue share under DRS v1, but the actual clearing revenue share is closer to 10%.

[860] Note that 11¢ equals 10% of $1.11.

Figure 14: An example of DRS v1 adjusting revenue shares at an impression level to increase impressions transacted.[861]



428. After the introduction of DRS v1, if publishers and bidders left their floor prices and bids unchanged, then both sides would benefit from the program: publishers would sell more impressions on AdX, increasing their revenues, and advertisers would win more impressions, increasing their surplus. I formalize this result in the following theorem, proved in Section XV.E.1.

[861] Presentation, "AdX DRS v1 launch review" (Feb. 13, 2015), GOOG-DOJ-13199952, at -954.

429. **Theorem 4**: If publishers did not change their floor prices and bidders did not change their bids, DRS v1 could only increase the number of impressions sold, publisher revenues, and advertiser surplus.

430. Theorem 4 assumes that publishers and bidders leave their floors and bids unchanged in response to DRS v1, which may be most relevant for a short-run analysis of the program. But, as I now explain, DRS v1 created new incentives for publishers and bidders to adapt their strategies to further increase their payoffs.

431. Under DRS v1, bidders were incentivized to reduce their bids for impressions. To see this, note that on each additional impression an advertiser won as a consequence of DRS v1, it was charged exactly its bid for the impression. This is not a threshold pricing rule (see Paragraph 61) because a winning bidder could sometimes lower the price it paid by reducing its bid for the impression. At the same time, publishers were incentivized to change their floor prices. Holding bids fixed, DRS v1 made higher floor prices less costly for a publisher, since AdX would sometimes compensate when the publisher set its floor price too high.

432. Incorporating all of these effects in a standard model of auction theory, I show in Theorem 5 that, if bidders and publishers adjust their bids and floor prices optimally, then publisher revenues increase under DRS v1 and advertiser surplus is approximately unchanged compared to the absence of DRS v1. The proof of Theorem 5 is in Section XV.E.2.

433. **Theorem 5:** Suppose that a publisher is selling an impression to a fixed set of bidders on AdX. The publisher does not know each bidder's value for the impression, and bidders do

not know each other's values for the impression, but all participants have the following information:

a. Each bidder knows its own value for the impression.

b. Each bidder's value is drawn from a commonly-known probability distribution and is statistically independent from other bidders' values.[862]

c. Each bidder determines a bid as a function of its value to maximize its surplus from the impression, given its probabilistic assessments about the bids of other bidders.

Then, if the publisher chooses revenue-maximizing floor prices, it earns a higher expected revenue on an impression to which DRS v1 is applied than it would without the program, and advertisers' surplus is unchanged.

434. Theorem 5 characterizes outcomes under the "independent private values model," which is a model adopted by Plaintiffs' experts.[863] While characterizing the theoretical effect of DRS v1 under more general modeling assumptions is difficult, there is a good reason to believe that it increased publisher revenues. As I show in Theorem 6, because DRS v1 reduces AdX's average revenue share, it can only be profitable to AdX if it increases publisher revenues from AdX. The proof of Theorem 6 is in Section XV.E.3.

[862] This implies that each bidder and the publisher can make a probabilistic assessment about other bidders' values and that estimates of other bidders' values would not be changed upon learning one bidder's value.

[863] Expert Report of M. Weinberg (Jun. 7, 2024), at ft. 62 ("I assume for the majority of this report that the advertisers have independent private values for impressions [...] and it is a sensible assumption to make").

435. **Theorem 6**: Revenue for AdX under DRS v1 increases *only if* publisher revenues from impressions sold via AdX also increase. Additionally, every percentage increase in revenue for AdX results in a proportionally larger increase in revenue for publishers.

436. Internal Google experiments confirm the theoretical predictions that DRS v1 increased publisher revenues, finding that publisher revenues from impressions sold via AdX increased by [redacted] after the introduction of the program.[864] Google also found that DRS v1 increased the overall AdX match rate [redacted][865] In the experiment, AdX exactly hit the [redacted] revenue share target set in the design of DRS v1.[866]

2. DRS v2: Restoring a Fixed Revenue Share by Averaging

437. DRS v2, launched in December 2016, restored the average AdX revenue share to the levels that applied prior to DRS.[867] It accomplished that by tracking the payments by each buyer to each publisher using "debt accounts" to ensure that, while the AdX revenue share applying to an individual impression could be higher or lower, AdX received its standard revenue share on average over all impressions.[868]

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[864] Email from [redacted]., "LAUNCHED! AdX Dynamic Revenue Share (DRS)" (Sep. 2, 2015), GOOG-AT-MDL-B-001391461, at -462 ("AdX publisher payout: [redacted]").

[865] Email from [redacted]., "LAUNCHED! AdX Dynamic Revenue Share (DRS)" (Sep. 2, 2015), GOOG-AT-MDL-B-001391461, at -461 ("Overall match rate for AdX publishers increases by [redacted]").

[866] Email from [redacted] "LAUNCHED! AdX Dynamic Revenue Share (DRS)" (Sep. 2, 2015), GOOG-AT-MDL-B-001391461, at -462 ("AdX margin: [redacted]").

[867] "AdX Dynamic Revshare v2 Launch Plan" (Aug. 2016), GOOG-DOJ-13208074, at -074 ("Launch DRS v2[:] Launched on 12/7").

[868] *See* Launch Doc, "AdX Dynamic Revshare v2: Launch Doc" (Jan. 13, 2016), GOOG-DOJ-13207875, at -879 ("In DRS v2, we expand per-query margin range to [redacted] with an objective to keep average adx margin at [redacted] over queries."). This average revenue share was a per-publisher and per-buyer average ("DRS v2 is implemented by dynamically expanding the AdX revshare based on the debt accumulated for each buyer and each seller.").

438. These debt accounts worked to maintain the average revenue share as follows.

439. On some impressions for which the highest bid was in the dynamic region, DRS v2 would decrease the AdX revenue share to ensure the impression would sell. Rather than charging each winning buyer its bid on those impressions with a discounted revenue share, DRS v2 charged each winning buyer an amount between its bid and the publisher's chosen floor price. AdX would then add a "debt" to the buyer's debt account, equal to the "discount" it had applied to the buyer's bid to allow that impression to transact, which is the amount that the buyer would need to raise its bid to win with the standard per-impression revenue share.[869] AdX would also add a "debt" to the publisher's debt account equal to its "discount" on the AdX revenue share, the amount that its floor price would need to be lowered in order to sell the impression with the standard per-impression revenue share.[870]

440. On some impressions for which the highest bid was above the amount required to win the impression in the absence of DRS, AdX would collect its standard revenue share plus an additional payment to recoup debts previously accrued by publishers and advertisers under DRS v2.[871] It did so while still charging the winning buyer a total amount less than its bid and paying the publisher more than its floor.[872] A winning buyer would be charged

[869] Design Doc, "Dynamic Revenue Sharing (DRS) V2 Proposal" (Mar. 24, 2015), GOOG-DOJ-13221355, at -356 [redacted]

[870] Design Doc, "Dynamic Revenue Sharing (DRS) V2 Proposal" (Mar. 24, 2015), GOOG-DOJ-13221355, at -356 [redacted]

[871] Design Doc, "Dynamic Revenue Sharing (DRS) V2 Proposal" (Mar. 24, 2015), GOOG-DOJ-13221355, at -356 ("We attempt to collect debt in a later query for [redacted], which we call the non-dynamic region.").

[872] Design Doc, "Dynamic Revenue Sharing (DRS) V2 Proposal" (Mar. 24, 2015), GOOG-DOJ-13221355, at -357 ("[W]e are careful to pick buyer_collection and publisher_collection to preserve constraints such as […] pay to the

the standard clearing price for the impression, plus a payment for any debt it had accrued, where this additional payment was chosen so that the total price of the impression was less than the bidder's bid.[873] If the buyer had set its own clearing price (by submitting a nonzero second bid), any additional payment it made as a consequence of its second bid was deducted from the debt balance as well.[874] [redacted].[875] I give a more detailed mathematical description of the workings of DRS v2 in Section XV.E.4.

441. Note that when recouping debts, AdX pays a portion of the recouped buyer debt back to the publisher. These amounts were chosen exactly to ensure that there is no double-charging of debt and, assuming all advertiser debts are recouped, the net debt accruing on average to publishers is zero, as described in Lemma 1, proved in Section XV.E.5.

442. **Lemma 1:** Suppose that AdX recoups all debts under DRS v2. Then, buyers accrue the full debt on each impression (equal to the difference between the floor price that would apply in the absence of DRS and the price it pays under DRS v2) and, after accounting

publisher at least his reserve[.] […] [T]he revised 2sided DRS never increases the price set above max(2nd bid, reserve).").

[873] Design Doc, "Dynamic Revenue Sharing (DRS) V2 Proposal" (Mar. 24, 2015), GOOG-DOJ-13221355, at -356 [redacted]

[874] Design Doc, "Dynamic Revenue Sharing (DRS) V2 Proposal" (Mar. 24, 2015), GOOG-DOJ-13221355, at -356 ("Finally we consider a second way in which buyers can decrease their debt [redacted]

[875] Launch Doc, "AdX Dynamic Revshare v2: Launch Doc" (Jan. 13, 2016), GOOG-DOJ-13207875, at -879 [redacted]).

for the payment of buyer debt to publishers, publishers accrue zero debt on net in expectation.

443. As Lemma 1 shows, publishers on average accrue *no net debt* on an impression cleared by DRS v2, while buyers pay on average a net debt equal to the difference between the floor price that would apply in the absence of DRS and the price it pays under DRS v2. This means that, after accounting for later debts paid, the effective price of an impression cleared by DRS v2 for the buyer is equal to the floor price that would apply in the absence of DRS v2. Publishers can increase their total revenues as a result of DRS v2 without changing their floor prices, as shown in Theorem 7, proved in Section XV.E.6.

444. **Theorem 7:** If publishers do not change their floor prices and buyers do not change their bids, then DRS v2 can only increase the total number of impressions sold and total publisher revenues compared to the absence of DRS.[876]

445. As in DRS v1, the implementation of DRS v2 changed the incentives for publishers and buyers in the auction. In Theorem 8, I show that when buyers and publishers respectively adapt their bids and floor prices to DRS v2, auction theory predicts that buyer surplus and publisher revenues will be the same as in the absence of DRS. This happens because, given the way that debts were recouped under DRS v2, buyers who bid into the dynamic region end up paying the same on average as they would need to bid to win the impression in the absence of DRS. Theorem 8 is proved in Section XV.E.7.

[876] I assume that AdX performs enough transactions that all debts in DRS v2 are resolved.

446. **Theorem 8**: If buyers and publishers set bids and floors to maximize their payoffs after the introduction of DRS v2, then buyer surplus and publisher revenues are the same as in the absence of DRS.

447. These theoretical results assume that all debts accrued during DRS v2 are collected, or equivalently, that all agents choose bids and floor prices *expecting* that all debts are collected. In their initial internal experiments on DRS v2, Google engineers found that the vast majority of buyers and publishers had very small quantities of uncollected debts ([redacted], respectively).[877] If small amounts of debt were left uncollected under DRS v2, I would expect the results above to be quantitatively similar.

448. In experiments conducted after the launch of DRS v2, Google found that DRS v2 led to a [redacted] net increase in *total* publisher revenues compared to no DRS, including revenue from remnant demand.[878] This latter experiment was performed on [redacted] of impressions, and found that [redacted] publishers saw an increase in total revenue.[879] Revenue also increased for publishers that used header bidding.[880] In pre-launch experiments, Google found that publisher revenues were approximately unchanged between DRS v1 and DRS v2.[881]

[877] *See* Presentation, "Two-sided Dynamic Revenue Sharing" (Nov. 28, 2014), GOOG-DOJ-13199584, at -598.

[878] Presentation, "Overall Pub Yield with DRS(v2)" (Apr. 7, 2016), GOOG-DOJ-13235100, at -101 [redacted]"), -102 ("[T]hat is the [redacted] compared with no-DRS, since all the numbers in the deck are DRSv2 vs no-DRS").

[879] Presentation, "Overall Pub Yield with DRS(v2)" (Apr. 7, 2016), GOOG-DOJ-13235100, at -106 ("Currently running [redacted] experiment."), -108 to -110 ("[redacted] publishers make more money in aggregate.").

[880] *See* Presentation, "Overall Pub Yield with DRS(v2)" (Apr. 7, 2016), GOOG-DOJ-13235100, at -114.

[881] Launch Doc, "AdX Dynamic Revshare v2: Launch Doc" (Jan. 13, 2016), GOOG-DOJ-13207875, at -875 ("Compared to v1, we observe […] almost neutral publisher payout").

449. Starting with the launch of DRS v2, publishers that did not want to participate could opt out and buyers that did not want to participate could choose not to submit bids below the floor price that they received in the bid request from AdX.[882]

3. Truthful DRS: Simplifying Bidding While Maintaining the Benefits of Dynamic Revenue Sharing

450. The final iteration of DRS, called Truthful DRS or tDRS, launched in July 2018.[883] tDRS maintained the benefits of dynamically adjusting the AdX revenue share by impression, while implementing a threshold pricing rule for buyers, which simplified bidding.[884] Under tDRS, AdX would choose its base revenue share for each impression [redacted] *before* collecting bids from AdX bidders, so that a winning buyer's bid did not affect its price.

[882] Buyers that did not wish to participate in DRS could opt out by not bidding in the dynamic region. Since 2016, all bidders see the highest among all the floor prices, including those determined by the value CPMs of remnant line items. With this information, bidders could decide whether they wanted to submit bids in the dynamic region. *See* Launch Doc, "Including Third-Party Threshold in the Revealed Reserve Prices to AdX Buyers" (Aug. 9, 2016), GOOG-DOJ-13208800, at -800 ("[redacted]."). Publishers could opt out of DRS in the user interface. *See* Comms Doc, "Dynamic Revenue Share" (Jan. 29, 2020), GOOG-DOJ-15130321, at -326 ("You may choose to opt-out of revenue share based optimizations in the AdX UI. If you opt-out we will apply your contracted revenue share to every Open Auction query and you will not benefit from the increased revenue from this optimization.").

[883] "2018 Sellside Launches Revenue Evaluation" (Jul. 19, 2019), GOOG-DOJ-13949282, at tab "Q3Q4 2018," row 7.

[884] Another source of complexity under the first two versions of DRS was that, to optimize bids, a buyer would need to track performance across many auctions (ones on which revenue shares were discounted and others for which debt were repaid), making experiments by that buyer on subsets of impressions more difficult. This was noted by Google internally as another motivation for the transition to tDRS. *See* "The Future of DRS + RPO" (Jul. 2, 2016), GOOG-DOJ-13205869, at -869 ("[T]his mechanism [DRS] can make it challenging for buyers who adopt sophisticated bidding strategies which rely on learning the smallest bid with which they could have won the auction.").

451. Like DRS v2, tDRS maintained its average revenue share for each publisher. Truthful DRS accomplished this by maintaining debt accounts for each publisher.[885] Unlike DRS v2, tDRS did not target an average AdX revenue share by buyer. For each impression, AdX chose a revenue share based on its predictions of AdX buyers' bids.[886] [redacted].[888] In short, AdX would discount its per-impression revenue share when it *predicted* that doing so would allow the impression to sell, and AdX would reclaim the discounts on other impressions for which it *knew* that a higher revenue share would not prevent the impression from selling. I provide the mathematical details of the operation of tDRS in Section XV.E.8.

452. There are several important properties of the tDRS program:

[885] This is different from the approach under DRS v2, in which debts were effectively paid by advertisers (see Lemma 1 in Section XV.E.5).

[886] Design Doc, "Truthful DRS Design Doc" (Mar. 24, 2017), GOOG-DOJ-13227256, at -260 [redacted]

[887] Design Doc, "Truthful DRS Design Doc" (Mar. 24, 2017), GOOG-DOJ-13227256, at -261 ("[redacted]

[888] Design Doc, "Truthful DRS Design Doc" (Mar. 24, 2017), GOOG-DOJ-13227256, at -261 [redacted]").

a. *For any fixed floor price, more impressions would be sold with tDRS than without it:* To see this, note that, without tDRS, AdX always applied its contracted revenue share to each impression, whereas with tDRS, AdX discounted its revenue share on some impressions, making it more likely for those impressions to sell. On the other hand, AdX increased its revenue share on impressions only if it already knew there was a sufficiently high bid for that impression, so that this increase in revenue share never reduced the number of impressions sold.

b. *tDRS was bidder-truthful:* tDRS used a threshold pricing rule, meaning that the price paid by a winning bidder was the lowest bid that they could have made to win the impression. In any single auction, that property makes it optimal for a buyer to bid its value, simplifying the bidding problem for buyers.

c. *On average, each publisher would receive its contracted share of the revenue:* The average revenue share on each impression for publishers, after accounting for adjustments to the debt account, was equal to the contracted revenue share: wherever the revenue share on an impression was below the standard rate, the publisher would repay debt on future impressions to restore the contracted average revenue share; wherever the revenue share was higher than the standard rate, the publisher had received an offsetting discount on another impression.

453. If publishers do not change their floor prices in response to tDRS, these three properties imply that tDRS would *always* increase publisher revenues from AdX compared to no DRS. This follows since bidding incentives were unchanged and more impressions were sold, so that the total revenue collected from bidders must increase, which, since the same

average revenue share applied to the publisher, means that the publisher's total revenue must also increase.

454. Similarly to DRS v1, tDRS reduced the cost to publishers associated with setting a higher floor price, creating an incentive for a publisher to increase its floor prices in response to tDRS. If a publisher also used header bidding, tDRS created an incentive for the publisher to further "inflate" the header bid it reported to GAM (that is, to trigger a line item in GAM with a value CPM greater than the header bidding bid, see Section X.D.2). Truthful DRS strengthened the incentive to inflate header bids because, via that strategy, a publisher could ensure that an impression sold on AdX only if the *net* payment it would receive (after accounting for debts it incurred under tDRS) was larger than the publisher's expected payments from header bidding. Google's internal documents suggest that many publishers did inflate header bids, as predicted.[889]

455. After accounting for these incentives to increase floor prices and inflate header bids, I show in Theorem 9 that a publisher can guarantee that tDRS increases its *total* revenues

[889] *See* Product Requirements Doc, "PRD: Unified 1P auction and Pricing rules" (Jul. 25, 2018), GOOG-DOJ-03998505, at -506 ("We've anecdotally heard from some publishers that they inflate the value CPM of remnant line items [...] publishers used to do this even before HB was popular."); Presentation, "First-price bidding" (Aug. 12, 2019), GOOG-DOJ-11406673, at -677 ("How boost works[:] The publisher inflates the HB bid before sending it as a floor to AdX[.] This is done to increase Adwords cost and to provide a better comparison between Adwords and header bidder bids[.]"); Email from [redacted], "Unified Auction Changes (Sellside) Executive Update - Aug 12, 2019" (Aug. 13, 2019), GOOG-DOJ-09713317, at -319 ("Today, these [publisher-]inflated CPMs are used to provide price pressure for AdX […] In practice, […] many publishers […] apply a boost to Header Bidding bids"); Presentation, "Changes to Ad Manager, AdMob auction" (Sep. 3, 2019), GOOG-DOJ-14549757, at -777 ("Last look [...] incentivizes pubs to inflate ('boost') the floor sent to AdX"). *See also* [redacted]

from all sources, including revenue from impressions with a competing header bidding offer. I provide a proof of Theorem 9 in Section XV.E.9.

456. **Theorem 9**: If publishers adjust their floor prices on AdX to maximize profits after the introduction of tDRS and tDRS accurately predicts buyers' bids, total publisher revenues from all demand sources will be higher with tDRS than with a fixed revenue share.

D. Responding to Plaintiffs' and Their Experts' Allegations

457. The opinions provided by Plaintiffs' experts are almost entirely limited to initial versions of DRS that were always intended to be improved upon. As I discussed above, Google planned a gradual introduction of DRS, testing elements of its design while monitoring the effects on advertisers and publishers, and some changes in publisher and advertiser outcomes could be expected as Google improved its DRS designs.[890]

1. Plaintiffs' and Their Experts Provide Misleading Analyses of DRS's Effects

458. Plaintiffs' experts allege that DRS harmed non-Google exchanges. Professor Gans states "[i]n combination with DA, DRS is most harmful to competition. [...] In a Waterfall setup, [...] DRS may foreclose rival exchanges from an opportunity to bid on those impressions."[891] Professor Weinberg concludes that DRS "increases Google's win rate and revenue and further decreases the win rate and revenue of other exchanges."[892] The evidence that I have reviewed suggests that these arguments omit DRS's main effects, which align with the program's stated purpose.

[890] *See, e.g.*, Presentation, "AdX DRS v1 launch review" (Feb. 13, 2015), GOOG-DOJ-13199952, at -958.

[891] Expert Report of J. Gans (Jun. 7, 2024), at ¶ 807.

[892] Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 224.

459. Recall that DRS was intended to "[increase] publisher and Google revenue by dynamically changing the AdX sell-side revenue share so that more auctions end with a winning buyer" rather than going unsold.[893] Internal Google experiments show that the most common effect of DRS was to cause an otherwise unmatched impression to be sold, rather than to win additional inventory off other exchanges.[894] Clearing these impressions would increase AdX's win rate and publisher revenues, but would do so *without* affecting the win rates or revenues of those other exchanges.

460[redacted], DRS still provided publishers with the opportunity to increase their revenues beyond what non-Google exchanges offered by allowing impressions to sell with "inflated" header bids in GAM.

461. Plaintiffs' experts allege that DRS harmed publishers by decreasing their revenue. Professor Gans focuses on DRS v2, stating "[t]he combined effects of Last Look and DRS v2 led to revenue losses for the publishers for the following reasons. When DRS v2 led to a decrease in the take rate to clear a binding price floor generated by Last Look, which is equal to the Header Bidding winning bid, the impression is awarded to AdX; the

[893] Comms Doc, "Dynamic Revenue Share" (Jan. 29, 2020), GOOG-DOJ-15130321, at -321.

[894] *See* "DRS and RPO interaction in Simulation" (Sep. 20, 2016), GOOG-AT-MDL-007375273, at -273. Experimental results show that, of the impressions on which DRS lowered the AdX revenue share, [redacted] occurred when the payment was determined by a third-party bid. By contrast, [redacted] occurred when the payment was determined by a publisher floor price. *See id.*

[895] *See* "DRS and RPO interaction in Simulation" (Sep. 20, 2016), GOOG-AT-MDL-007375273, at -273. Experimental results show that, of the impressions on which DRS lowered the AdX revenue share, [redacted] occurred when the payment was determined by a third-party bid. By contrast, [redacted] occurred when the payment was determined by a publisher floor price. *See id.*

publisher gets paid only 1 cent higher than the Header Bidding winning bid."[896] To support his conclusion, he provides an example in which the highest header bid is $6 and the two highest bids from AdX are $7 and $5, and AdX's reserve is $3. Without DRS, AdX would apply a [redacted] revenue share, resulting in bids of [redacted] and [redacted] net of the revenue share. In this case [redacted] wins the impression and the publisher receives [redacted]. Under DRS v2, AdX would apply a [redacted] revenue share, resulting in a high bid of [redacted]. In this case, AdX wins the impression and the publisher receives [redacted]. However, he claims the publisher would be worse off because "the publisher would incur the debt of [redacted]."[897, 898]

462. Professor Gans' analysis is flawed on three counts: (1) his calculation of debt under DRS v2 is misleading; (2) he omits the more frequent case in which the floor price is one set by the publisher; and (3) he omits the benefits when an optimizing publisher handles header bids correctly. While my discussion of (1) is specific to DRS v2, my discussion of (2) and (3) applies to all three versions of DRS.

463. *First*, by only looking at a single transaction, Professor Gans ignores the details of debt recollection under DRS v2. In his example, the advertiser also incurs a debt of $[redacted]. Assume that after his example, a second impression arrives. The two highest bids from AdX are $7 and $5 and AdX's reserve is $3, but there is no header bid. Under

[896] Expert Report of J. Gans (Jun. 7, 2024), at ¶ 809.

[897] Expert Report of J. Gans (Jun. 7, 2024), at ¶ 810.

[898] Professor Gans assumes that DRS v2 charged the winning AdX bidder its full bid of [redacted] hence the [redacted] revenue share. The version of DRS v2 that launched charged the winning AdX bidder the average of its bid and the floor price, equaling $[redacted] and leading to a revenue share of [redacted]%. The publisher would then incur debt equal to [redacted] However, this difference does not qualitatively affect the analysis, so I use his numbers for ease of exposition.

DRS v2, AdX wins the impression, and the bidder pays [redacted] The publisher receives [redacted] Both the bidder and the publisher's debt accounts are cleared after this transaction. In sum, the publisher receives the same revenue from the two impressions under DRS v2 as it would without DRS. More generally, I show in Lemma 1 that publishers accrue zero net debt in expectation, meaning that even though the publisher incurs [redacted] of "debt" in Professor Gans' example, the publisher receives the same revenue from AdX in expectation as it would receive from the header bidder. Plaintiffs' expert Professor Weinberg also reaches this same conclusion.[901]

464. *Second*, as explained above, Professor Gans' example applies only when the floor is set by a header bidding line item, but the more frequent effect of DRS was to create additional revenue for the publishers by helping it sell impressions that would otherwise go unsold.[902] Professor Gans does not attempt to weigh the revenue and efficiency gains from the additional transactions DRS enabled against its alleged downsides.

465. *Third*, Professor Gans' example would never arise if the publisher adopted a better strategy than directly passing the header bid to AdX. Such a publisher would *inflate* the header bid before reporting it to DFP, allowing the publisher to earn strictly more revenue from the sale of the impression. In Professor Gans' example, if the header bid is inflated

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[899] The bidder's payment equals the clearing price plus the bidder's debt.

[900] The publisher's payment equals [redacted] the bidder's payment, minus the publisher's debt.

[901] *See* Expert Report of M. Weinberg (Jun. 7, 2024), at Appendix G, ¶ 65.

[902] *See* "DRS and RPO interaction in Simulation" (Sep. 20, 2016), GOOG-AT-MDL-007375273, at -273. Experimental results show that, of the impressions on which DRS lowered the AdX revenue share, [redacted] occurred when the payment was determined by a third-party bid. By contrast, [redacted] occurred when the payment was determined by a publisher floor price. *See id.*

to [redacted], then under DRS, AdX would win the impression only if it is able to provide a buyer willing to pay *more* than [redacted], thereby increasing the expected publisher revenue by at least [redacted] over the header bidder's [redacted] bid.

466. Google's internal experiments also showed that publishers benefited from DRS.[903] Citing a 2016 experiment in which DRS v2 led to revenue increases [redacted] publishers, Professor Gans focuses on the finding that "[redacted] saw their revenue decrease by around [redacted]."[904] That focus ignores the significant revenue increases for the other [redacted] publishers, which more than offset the minor revenue decreases experienced by the remaining [redacted] publishers. In addition, Professor Gans' interpretation overlooks that the document itself posits that "the fact that some publishers have their overall revenue decreased by DRS comes from noise due to the fact that this is a small experiment."[905] Finally, starting with the launch of DRS v2, publishers that did not want to participate in DRS could opt out and buyers could also avoid DRS by not submitting bids lower than the floor price shared in the bid request.[906]

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[903] Presentation, "[redacted].

[904] Expert Report of J. Gans (Jun. 7, 2024), at ¶ 840.

[905] "Does DRS make more money for publishers?" (Mar. 17, 2016), GOOG-DOJ-13204346, at -349.

[906] Buyers that did not wish to participate in DRS could opt out by not bidding in the dynamic region. Since 2016, all bidders see the highest among all the floor prices, including those determined by the value CPMs of remnant line items. With this information, bidders could decide whether they wanted to submit bids in the dynamic region. *See* Launch Doc, "Including Third-Party Threshold in the Revealed Reserve Prices to AdX Buyers" (Aug. 9, 2016), GOOG-DOJ-13208800, at -800 ("[redacted] Publishers could opt out of DRS in the user interface. *See* Comms Doc, "Dynamic Revenue Share" (Jan. 29, 2020), GOOG-DOJ-15130321, at -326 ("You may choose to opt-out of revenue share based

2. Google Did Not Mislead Buyers and Publishers About DRS

467. Plaintiffs' experts claim that buyers and publishers were not able to respond optimally to DRS because Google "concealed material information."[907] Professor Weinberg states, "Since publishers believed that AdX runs a regular second-price [auction] with their given reserve price and a [redacted] a strategic publisher would set a price floor that maximized their revenue under these circumstances. Had they known AdX dynamically adjusted its take rate, publishers would set different price floors."[908] Similarly, Professor Gans states that "Google intentionally omitted telling publishers that they were enrolled in DRS,"[909] and Professor Pathak states that "Google never disclosed this conduct to advertisers or publishers who sell or buy impressions through AdX."[910]

468. These claims of deception are contradicted by disclosures in the AdX Help Center starting from at least August 2015—before the launch of DRS v1. It says, "DoubleClick Ad Exchange determines the winning bidder based on the highest net bid submitted. Note that the net bid reflects any adjustments Ad Exchange may, at its discretion, have made to the bid submitted by the buyer for the purpose of optimizing the auction. [...] In some cases, the auction may close at a price lower than the reserve price applied, due to auction optimizations. Sellers are paid the Ad Exchange closing price, net of Google's revenue share, but will receive, subject to the terms governing their use of Ad Exchange, no less

optimizations in the AdX UI. If you opt-out we will apply your contracted revenue share to every Open Auction query and you will not benefit from the increased revenue from this optimization.").

[907] Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 219.

[908] Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 219.

[909] Expert Report of J. Gans (Jun. 7, 2024), at ¶ 828.

[910] Expert Report of P. Pathak (Jun. 7, 2024), at ¶ 188.

than the min CPM applied to the auction."[911] Before the launch of DRS v2, the Help Center page was updated to include the possibility that some impressions would close above or below the contracted revenue share, while still ensuring that publishers would receive at least their contracted revenue share in a given month.[912,913]

469. Professor Weinberg's claim that "[s]ince DRSv1 was not disclosed to the advertisers, they would still bid their true value for impressions" is doubly wrong, both because DRS v1 was disclosed and because buyers could quickly and easily detect its application.[914] Every time DRS v1 affected a buyer's outcome, it caused the buyer to win an impression on which it had bid below the floor price and to pay the amount of its bid.[915] Without DRS, that outcome was impossible. DRS leaves an unmistakable trace that can be detected

[911] *See* Help Center Page, "Ad Exchange auction model" (Aug. 4, 2015), GOOG-AT-MDL-C-000035251, at -251 ("DoubleClick Ad Exchange determines the winning bidder based on the highest net bid submitted. Note that the net bid reflects any adjustments Ad Exchange may, at its discretion, have made to the bid submitted by the buyer for the purpose of optimizing the auction. [...] In some cases, the auction may close at a price lower than the reserve price applied, due to auction optimizations. Sellers are paid the Ad Exchange closing price, net of Google's revenue share, but will receive, subject to the terms governing their use of Ad Exchange, no less than the min CPM applied to the auction.").

[912] *See* Help Center Page, "Ad Exchange auction model" (Jun. 14, 2016), GOOG-AT-MDL-C-000035252, at -252 ("DoubleClick Ad Exchange determines the winning bidder based on the highest net bid submitted. Note that the net bid reflects any adjustments Ad Exchange may, at its discretion, have made to the bid submitted by the buyer for the purpose of optimizing the auction. [...] To optimize the auction, Google may choose to close an auction at a price lower than the reserve price that would have otherwise been applied. In such cases, the winning buyer may pay a price below the reserve and therefore receive a discount on its bid. A buyer that has received discount(s) on its bid(s) may face higher reserve prices in subsequent transactions to offset such discount(s). Subject to the terms governing their use of Ad Exchange, sellers are paid the Ad Exchange closing price, net of Google's revenue share, but will receive no less than the min CPM they specified for the auction. Unless the 'per-query revenue share' setting is enabled by a Seller, auction optimizations may result in an auction closing at a price lower than the reserve price that would have otherwise been applied. Because the Seller will always be paid at least its specified min CPM, the Seller may receive more than its contracted revenue share on the transaction. In subsequent transactions, the Seller's revenue share may then be reduced to offset the prior earnings in excess of the contracted revenue share, but the Seller will always receive at least its contracted revenue share across all its Ad Exchange transactions in a given month.").

[913] DRS v2 was launched in December 2016. "AdX Dynamic Revshare v2 Launch Plan" (Aug. 2016), GOOG-DOJ-13208074, at -074.

[914] Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 220.

[915] DRS v1 lowers AdX's revenue share on impressions in which its highest bid net of the [redacted] revenue share is below the floor price.

every time it reduces AdX's revenue share. A minimally attentive buyer who failed to read Google's disclosure could still discover DRS by noticing when a bid below the floor price was accepted at a price equal to its bid and, by applying logic or just conducting routine experiments, optimize its bidding strategy to account for that possibility.

3. Non-Google Exchanges Also Dynamically Adjusted Revenue Shares

470. Professor Gans claims that only AdX had the requisite scale and incentive to implement DRS. He states, "Had Google not had monopoly power on the sell side of the market or been vertically integrated into the exchange market, it would not have had the ability or the incentive to undertake this conduct that harmed competition."[916] In fact, the same incentive applies to every exchange and the ability of other exchanges to undertake this conduct is revealed by the evidence. Non-Google exchanges [redacted] implemented similar programs, increasing and decreasing their revenue shares on individual impressions based on the floor prices and the bids they had received.[917]

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[916] Expert Report of J. Gans (Jun. 7, 2024), at ¶ 777.

[917] *See* [redacted] *See also* Sarah Sluis, "Explainer: More On The Widespread Fee Practice Behind The Guardian's Lawsuit Vs. Rubicon Project," AdExchanger (Mar. 30, 2017), https://www.adexchanger.com/ad-exchange-news/explainer-widespread-fee-practice-behind-guardians-lawsuit-vs-rubicon-project/ ("Exchanges might also vary their fee based on the difference between an advertiser's bid and the clearing price, PubMatic confirmed.").

4. DRS Did Not Remove Barriers to Low-Quality Ads

471. Professor Gans alleges that "DRS harmed publishers by lowering floors for low-quality ads."[918] Professor Gans provides no evidence of systematic differences in ad quality or that DRS actually resulted in low-quality ads winning auctions, instead asserting without support that "[p]ublishers use price floors to control the quality of ads showing on their webpage."[919] In reality, if a publisher wishes to exclude some types of ads, it can use content filters to achieve that result.[920] If the publisher wishes to show the ad only when the price is sufficiently high, it can set its floor price to accomplish that too: DRS allows the ad to transact only if the publisher receives at least that floor price.

5. Plaintiffs Mischaracterize Google's Combined Usage of DRS and RPO

472. Plaintiffs claim Google used DRS and RPO "in conjunction with each other to further the advantages provided by any one of these programs in isolation," stating "RPO would increase the price paid by an advertiser by raising the floor, while DRS would ensure that the advertiser's bid nevertheless cleared the higher floor set by RPO, which exacerbates harm to competition in the exchange market."[921] This depiction of Google's usage of DRS and RPO is misleading. Early on, Google saw "disab[ling] DRS on RPO floors" as a "[s]tep along the way" to "[m]aking DRS truthful,"[922] and eventually did disable DRS

[918] Expert Report of J. Gans (Jun. 7, 2024), at ¶ 855.

[919] Expert Report of J. Gans (Jun. 7, 2024), at ft. 1080.

[920] *See* Google, "Block sensitive categories," Google Ad Manager Help (accessed Jun. 25, 2024), https://support.google.com/admanager/answer/2541069?sjid=14973969736947852707-EU#available-sensitive ("You can block groups of ads that are considered 'sensitive' due to the nature of the business or ad […] Our system classifies ads automatically, and we don't rely on advertiser-provided categorization.").

[921] Fourth Amended Complaint ¶ 350.

[922] Presentation, "AdX Dynamic Price" (Nov. 30, 2016), GOOG-DOJ-13206921, at -928.

on RPO-set floors in preparation for the launch of tDRS.[923] In practice, DRS and RPO interacted on less than [redacted] of impressions.[924]

[923] Launch Details Spreadsheet, Launch 193573 (Sep. 1, 2023), GOOG-AT-MDL-009644409, at cells B2, D2 [redacted]). tDRS was launched in July 2018. *See* "2018 Sellside Launches Revenue Evaluation" (Jul. 19, 2019), GOOG-DOJ-13949282, at tab "Q3Q4 2018," row 7.

[924] *See* "DRS and RPO interaction in Simulation" (Sep. 20, 2016), GOOG-AT-MDL-007375273, at -273. In the first table, the entry under the column "True" and the row "DYNAMIC_RESERVE" represents the percentage of impressions in which 1) AdX's bid fell in the dynamic region and 2) RPO set AdX's floor price, with a value of [redacted]

XIII. OPEN BIDDING AND UNIFIED FIRST PRICE AUCTION: IMPROVING PUBLISHERS' ABILITY TO ACCEPT BIDS FROM NON-GOOGLE EXCHANGES

A. Overview

473. Google began testing **Open Bidding** (previously known as Exchange Bidding, and internally also known as Jedi, EBDA, and demand syndication) in 2016[925] and officially launched the program in April 2018.[926] Open Bidding allowed publishers to accept bids for impressions from non-Google exchanges on Google Ad Manager, increasing the thickness of Google's platform. Accepting bids from other exchanges on GAM—in a way that protected the interests of both advertisers and publishers—required careful design and ultimately led to other changes on GAM, including the transition to the Unified First Price Auction (UFPA) in 2019.[927]

474. Google described Open Bidding as its "answer to header bidding."[928] Relative to header bidding, Open Bidding brought many advantages to publishers, including speed, streamlined payments, simpler configuration, and reduced computational burden on end

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[925] *See* Presentation, "Demand Syndication" (Feb. 17, 2016), GOOG-DOJ-09459336, at -348.

[926] *See* Jonathan Bellack, "Exchange Bidding now available to all customers using DoubleClick for Publishers," Google Ad Manager (Apr. 4, 2018), https://blog.google/products/admanager/exchange-bidding-now-available-to-a/ ("Exchange Bidding now available to all customers using DoubleClick for Publishers […] With Exchange Bidding, publishers can increase revenue by allowing multiple exchanges to compete with each other—and with DoubleClick Ad Exchange—in a unified auction.").

[927] Comms Doc, "Ad Manager Unified 1st Price Auction" (Sep. 27, 2019), GOOG-DOJ-09714662, at -662 ("[W]e are transitioning publisher inventory to a unified, 1st price auction for Google Ad Manager.").

[928] Presentation, "Demand Syndication" (Feb. 17, 2016), GOOG-DOJ-09459336, at -337 ("Demand Syndication is our answer to header bidding - a superior product for allowing pubs to get per-query bids from non-AdX exchanges[.]").

users' browsers.[929, 930, 931] The popularity of Open Bidding among publishers speaks to these benefits.[932]

475. Plaintiffs' allegations regarding Open Bidding and the UFPA are factually incorrect and fail to account for the incentives of participants.

a. *First*, Plaintiffs' allegations that Open Bidding was devised to "maintain its exchange monopoly and exclude competition"[933] from other exchanges using header bidding is inconsistent with the details of the Open Bidding program. Contrary to Plaintiffs' descriptions, publishers and exchanges were not forced to adopt Open Bidding and could maintain existing header bidding configurations. The data I have reviewed suggests that the vast majority of publishers using Open Bidding continue to use header bidding.

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[929] In this section, I use the term "header bidding" to refer to client-side header bidding. Some use the term "header bidding" to include server-side header bidding tools, including Open Bidding. For a comparison of Open Bidding and header bidding, see Comms Doc, "Open Bidding on Ad Manager (fka Exchange Bidding)" (Aug. 2019), GOOG-DOJ-15389438, at -440 to -442.

[930] For a comparison of timeouts, see Comms Doc, "RTB Timeouts" (Oct. 2019), GOOG-DOJ-15232606, at -609 ("Google's lower bid timeouts should have a slightly better user experience with lower latency").

[931] *See* Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 24; Comms Doc, "Open Bidding on Ad Manager (fka Exchange Bidding)" (Aug. 2019), GOOG-DOJ-15389438, at -438 ("Eliminate operational inefficiencies such as line item complexity and latency that exists with header bidding […] Easy to set up, view/analyze reports and unified payments […] Allows exchanges to respond to RTB call-outs […] Provides integrated reporting and billing for exchange bidding transactions won by 3rd party exchanges"), -441 to -442.

[932] As of March 2023, [redacted] North American publishers using Google Ad Manager used Open Bidding for some impressions. Of those publishers, [redacted] use header bidding. This statistic is based on [redacted]" *See* [redacted], Appendix A (Oct. 6, 2023), GOOG-AT-MDL-C-000012826, at -874. Publishers are grouped by their network_id and ranked according to the number of queries matched in the dataset. Code for this result can be found in code/hb_monitor_ob_freq.py in my supporting materials, and the output is saved in code/logs/hb_monitor_ob_freq.txt.

[933] Fourth Amended Complaint ¶ 367.

b. *Second*, Plaintiffs and their experts allege that Google shared minimum bid to win (MBTW) data with Open Bidding exchanges (but not header bidding), allowing them "to adjust their future bidding strategy to continue trading ahead of exchanges returning bids through header bidding and underpaying for publishers' impressions"[934] and to "effectively recreate[] Last Look."[935] But bidders and bids vary from auction to auction, so Plaintiffs and their experts' suggestion that AdX buyers could exactly predict competitors' bids is incorrect. These allegations also significantly overstate the importance of receiving MBTW data and fail to consider numerous alternatives that enabled those other bidders to optimize bids.

c. *Third*, Plaintiffs and their experts claim that, in 2018, Google began redacting data fields in auction data shared with publishers to "cripple[] publishers' ability to measure the success of rival exchanges in header bidding."[936] But, these claims ignore the historical context of changes in data-sharing policies, which were

[934] Fourth Amended Complaint ¶ 380 ("Specifically, in 2019, DFP began sharing sensitive pricing information derived from publishers' sensitive clearing auction records (which Google called "Minimum Bid to Win" data) with exchanges in Exchange Bidding. Google's AdX exchange and other exchanges in Exchange Bidding use this data to adjust their future bidding strategy to continue trading ahead of exchanges returning bids through header bidding and underpaying for publishers' impressions.").

[935] Expert Report of P. Pathak (Jun. 7, 2024), at ¶ 199 ("Minimum Bid to Win data effectively recreates Last Look, because AdX and Exchange Bidding buyers can use the information from Minimum Bid to Win on their next auctions, while Header Bidding buyers cannot."). *See also* Fourth Amended Complaint ¶ 381 ("Google compounded this Exchange Bidding advantage with a new secret bid optimization scheme that allowed Google to recapture the advantages it had under Last Look. The new scheme uses information about publishers' ad server user IDs and rival exchanges' bids to accurately predict the amount to bid, effectively permitting Google to re-engineer the ability of AdX and Google's ad buying tools to trade ahead of rivals exchanges in Exchange Bidding. As a Google planning document outlines: 'If we knew our competitor's bid exactly, we can simply bid a cent above that[.] But we don't have this information before the auction, so we need to predict [the] competitor's bid.'").

[936] Fourth Amended Complaint, Section VII.D.3.iii ("Google cripples publishers' ability to measure the success of rival exchanges in header bidding (2018 to present)."). *See also* Expert Report of P. Pathak (Jun. 7, 2024), at ¶ 150 ("The redaction of the DT protected AdX against the threat of Header Bidding because it removed publishers' ability to measure Header Bidding results and effectively target users."); Expert Report of J. Gans (Jun. 7, 2024), at ¶¶ 683-85 ("In short, by changing the way that KeyPart was generated (or "re- encoding" it), Google removed the ability for publishers to match DT files together. [...] By redacting these fields, Google prevented publishers from knowing relevant identifying information about auction winners.").

introduced in response to demands from buyer-customers and emerging privacy concerns. While Professor Gans asserts that "Google's claim that it redacted data based on privacy concerns is pretextual,"[937] he primarily justifies his opinion by a mischaracterized quote, ignores other evidence, and does not acknowledge Google's contractual obligations. Plaintiffs and their experts also fail to account for publishers' alternative means for measuring the "performance of exchanges in header bidding,"[938] such as experimentation and the use of other data fields.

B. Open Bidding: Google's Response to the Flaws of Header Bidding

476. Open Bidding was designed as Google's "answer to header bidding," incorporating more real-time bids from non-Google exchanges into Google's auction.[939] Although implementations of header bidding also enabled publishers to collect real-time bids from non-Google exchanges, those implementations tended to have several downsides, as described next.

[937] *See* Expert Report of J. Gans (Jun. 7, 2024), at Section VII.D.2 ("Google's claim that it redacted data based on privacy concerns is pretextual.").

[938] Fourth Amended Complaint ¶ 387.

[939] Presentation, "Demand Syndication" (Feb. 17, 2016), GOOG-DOJ-09459336, at -337 ("Demand Syndication is our answer to header bidding - a superior product for allowing pubs to get per-query bids from non-AdX exchanges.").

477. *First, latency.* Common implementations of header bidding increased latency.[940] An internal Google study found that header bidding increased ad loading times by approximately [redacted], and academic researchers found that header bidding latency was around [redacted] times that of the waterfall.[941] Latency not only degrades the end user experience, but in so doing, also harms advertisers and publishers.[942] By increasing the likelihood that an end user leaves the website before the ad is presented, latency harms publishers by potentially preventing a user from viewing an ad for which the publisher would be compensated if the ad had been displayed.[943] Latency also harms advertisers by reducing the effectiveness of online display advertising campaigns.

[940] Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 24 ("Most header bidding has traditionally taken place client-side, meaning the page sends out requests to individual ad exchanges and other demand sources, processes the responses, and then runs an auction, all via Javascript code running on the page. This may introduce latency issues and slow page loads."). *See also* Presentation, "Header Bidding T1 Impact" (Sep. 24, 2015), GOOG-DOJ-04430492, at -501 ("3. User's browser triggers the buyer's pixel, which communicates with the Header Bidding buyer's server. a. This may result in page load latency as the page will not load until the header script completes […] 4. HB buyer's server returns a decision […] (This results in further latency as the DFP tag is dependent on the Header Bidder's call resolving.)"),-502 ("Cons: Increased latency - especially in mobile and video = decreased user experience."); Vishveshwar Jatain, "Understanding Header Bidding And How To Leverage It," Forbes (Sep. 17, 2019), https://www.forbes.com/sites/forbescommunicationscouncil/2019/09/17/understanding-header-bidding-and-how-to-leverage-it/?sh=332097315c1 ("Client-side header bidding […] increased page latency because executing auctions takes bandwidth and computing resources.").

[941] Presentation, "Header Bidding Observatory #1" (Jan. 2017), GOOG-DOJ-AT-01027937, at -956 ("All things equal, there is a [redacted] in ads load speed because of Header Bidding"); Pachilakis, M., Papadopoulos, P., Markatos, E. P., & Kourtellis, N. (2019). No More Chasing Waterfalls: A Measurement Study of the Header Bidding Ad-ecosystem. In *IMC '19: Proceedings of the Internet Measurement Conference* (pp. 280-293).

[942] Interactive Advertising Bureau, "Glossary: Digital Media Buying & Planning" (Apr. 2016), https://www.iab.com/wp-content/uploads/2016/04/Glossary-Formatted.pdf, at p. 10 ("Latency sometimes leads to the user leaving the site prior to the opportunity to see the ad.").

[943] *See, e.g.*, DoubleVerify, "Latency in Digital Advertising: A Guide for Publishers," DV Publisher Insights (Oct. 21, 2019), https://pub.doubleverify.com/blog/latency-in-digital-advertising-a-guide-for-publishers/ ("High latency kills user experience and publisher revenue."); Google, "[UA] Latency and why it impacts Google Ads Clicks and Analytics Sessions," Google Analytics Help (accessed July. 24, 2024), https://support.google.com/analytics/answer/4589209?hl=en ("As a general rule, users on the internet are not very patient. This is evident from studies such as the KissMetrics study that elicited some sobering statements like: 'A one-second delay in page response can result in a 7% reduction in conversions.' along with '47% of consumers expect a web page to load in two seconds or less.' What does this mean for you? If your website loads too slowly, then there is a possibility that users are leaving and going to your competitors, especially if competitors are able to deliver the same content quickly.").

478. *Second, payment discrepancies.* There were reports of payment discrepancies, where publishers' expected receipts from header bidders did not match eventual payments.[944] In contrast to impressions sold on AdX (where AdX would act as a clearinghouse, collecting payments from bidders on behalf of publishers), publishers needed to manage their own billing and reconciliation for impressions sold via header bidding. Discrepancies of up to [redacted] could arise because different partners might apply different standards for verifying that impressions were not fraudulent or double-counted.[945]

479. *Third, complexity.* Header bidding could be challenging for a publisher to configure, requiring it to place code in the header of its website to request, collect, and compare bids before calling the publisher's ad server.[946] Header bidding also required a publisher to

[944] Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 24 ("Header bidding is also not transparent because, although the publisher 'accepts' the impression at a certain price, the header bidder may not actually pay the sum indicated in its bid."); Presentation, "Header Bidding Observatory #1" (Jan. 2017), GOOG-DOJ-AT-01027937, at -955 ("A comparison of HB reports vs DFP reporting showed significant discrepancies [in revenue]"). *See also* James Curran, "For Publishers, Header Bidding Discrepancies Can Outweigh Revenue Lift," AdExchanger Opinion Page (Jul. 8, 2016), https://www.adexchanger.com/the-sell-sider/publishers-header-bidding-discrepancies-can-outweigh-revenue-lift/ ("Publishers need to create a more realistic calculation of header bidding revenue by factoring discrepancies into their line-item valuations. Some header bidding solutions can cause up to a [redacted] discrepancy between the publisher ad server impression reports and the impression reports from the programmatic partner. That means a [redacted] once you account for the adjustments made by the exchange for viewability, verification and performance tracking.").

[945] James Curran, "For Publishers, Header Bidding Discrepancies Can Outweigh Revenue Lift," AdExchanger Opinion Page (Jul. 8, 2016), https://www.adexchanger.com/the-sell-sider/publishers-header-bidding-discrepancies-can-outweigh-revenue-lift/ ("Publishers need to create a more realistic calculation of header bidding revenue by factoring discrepancies into their line-item valuations. Some header bidding solutions can cause up to a [redacted] between the publisher ad server impression reports and the impression reports from the programmatic partner. That means a [redacted] once you account for the adjustments made by the exchange for viewability, verification and performance tracking.").

[946] One publisher described the time required to integrate an SSP with a leading header bidding wrapper as "20 hours of work" (versus Open Bidding's "20 minutes"). Sarah Sluis, "Google Ad Manager Builds A Bridge To Prebid—But Don't Call It A Two-Way Street," AdExchanger (Apr. 27, 2022), https://www.adexchanger.com/platforms/google-ad-manager-builds-a-bridge-to-prebid-but-dont-call-it-a-two-way-street/. Another industry source compared header bidding to previous ad configurations: "It's not just a little more work, it's probably 100X as much work to traffic for most publishers." Ad Ops Insider, "Header Bidding Explained Step-by-Step" (Jun. 8, 2015), https://www.adopsinsider.com/header-bidding/header-bidding-step-by-step/.

take on many of the tasks that were traditionally performed by ad servers (or pay another publisher tool to do so), including billing, reporting, data security, and ad fraud prevention.[947]

480. Google found that publishers sought the ability to accept real-time bids directly from other exchanges on Google's platform.[948] In 2016, as header bidding was growing in popularity with publishers, Google started developing and testing Open Bidding, a product to accept real-time bids in that way—without the drawbacks of header bidding.[949]

C. Meeting the Challenge of an "Auction of Auctions": The Evolution of Open Bidding and the Unified First Price Auction

481. Designing an "auction of auctions" to improve on the flaws of header bidding while protecting the interests of both advertisers and publishers was challenging, in part because of differences between the auction formats on AdX and other exchanges. AdX ran a second-price auction, while many other exchanges had transitioned to

[947] *See* James Curran, "For Publishers, Header Bidding Discrepancies Can Outweigh Revenue Lift," AdExchanger Opinion Page (Jul. 8, 2016), https://www.adexchanger.com/the-sell-sider/publishers-header-bidding-discrepancies-can-outweigh-revenue-lift/ ("Managing header bidding discrepancies, like much of digital ad tech, is complex and time consuming. In order to make these changes, publishers need to recalibrate hundreds if not thousands of line items, which makes header bidding just as manual as a waterfall setup. This manual labor is another costly factor that publishers must include when determining the value of header bidding."); Ross Benes, "Unraveling header bidding's problems with user data," Digiday (Mar. 20, 2017), https://digiday.com/media/header-bidding-security/ ("[A]n overlooked downside [of header bidding] is that it can expose user data by allowing all bidders to access audience data. Header bidding also makes it easier for fraudsters to hide in the noise created by the vast amount of data points that come from multiple parties bidding on all available impressions. […] Hlavacek pointed out that with multiple partners bidding on all impressions available in the auction, header bidding significantly increases the amount of data points in the exchanges. Other sources said it's this data deluge that is most problematic when it comes to security.").

[948] Presentation, "Demand Syndication" (Feb. 17, 2016), GOOG-DOJ-09459336, at -337.

[949] *See, e.g.*, Presentation, "Demand Syndication" (Feb. 17, 2016), GOOG-DOJ-09459336, at -337.

non-second-price auction formats.[950] Bids that are optimized for different auction formats are not easily compared: in a first-price auction, bidders optimize by shading their bids below their values to maximize their payoffs, while bidders in a second-price auction find it optimal to bid their values, as I discuss in Section III.C.3. Designing an auction that incorporated bids from auctions run by other exchanges ultimately led to additional changes in the AdX auction design, including the transition to the Unified First Price Auction.

1. *"Alpha" Design Highlights Difficulty of Auction of Auctions*

482. The first "alpha" design of Open Bidding, in June 2016, incorporated bids from authorized exchanges in the AdX second-price auction, which AdX would compare to bids from Google's buy-side tools and Authorized Buyers.[951] When an auction was won by an Open Bidding buyer, GAM collected a revenue share of [redacted][952]

483. By continuing to receive bids from DSPs and other Authorized Buyers in a second-price auction, the Open Bidding design aligned with the way that those buyers had previously competed in the AdX second-price auction. Even so, this prototype design of Open Bidding was reportedly unpopular with non-Google exchanges because AdX could win

[950] Between late 2017 and early 2018, during the design phase of Open Bidding, Google estimated that the percentage of all queries conducted in "First-price auction" and "Second-price auction with anomalies" formats increased from [redacted] *See* Presentation, "DV360, Third Party Exchanges, and Outcome-Based Buying" (Oct. 16, 2018), GOOG-DOJ-12038253, at -298 ("In fact, exchanges are openly moving more and more to first price auctions.").

[951] *See* Presentation, "Exchange Bidding 'Last Look' leak" (Apr. 5, 2017), GOOG-DOJ-14024199, at -200 to -201 ("The initial design for exchange bidding in dynamic allocation (EBDA) worked almost exactly like Header Bidding when used with DFP. In the initial EBDA design, the bid submitted by an exchange was treated like a price derived from a line item and could become the floor price in the AdX auction. This part of the process was sometimes referred to as 'last look.'").

[952] Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 27 ("Up to at least December 2021, for publishers that utilized Open Bidding, when an auction was won by an Open Bidder, Google Ad Manager's standard charges for web display ads were [redacted] for GAM360 customers and [redacted] for other GAM customers, and Google's standard charges for app and instream video ads were [redacted].").

the auction with any bid higher than the bid made by each of the exchanges (and any other floor prices), at a price determined by the second-price auction logic (which could equal the largest bid from the other exchanges).[953] Although different in nature from the so-called "last look" over remnant line items (including header bids),[954] this Open Bidding design was also characterized as a "last look" for AdX.

484. By their nature, "alpha" launches are used to identify problems with a product's design before testing the product on a larger group of users. The challenges associated with the "alpha" launch of Open Bidding highlighted the complication associated with incorporating bids from other exchanges on AdX. Doing that effectively was not as simple as treating the bids from other exchanges in the same ways as other bids in the AdX auction. Instead, incorporating bids from other exchanges required additional changes to the AdX auction design.

2. Google Removes the So-Called "Last Look" Over Open Bidding, Challenging Its Second-Price Auction Design

485. In March 2017, Google responded to feedback and redesigned the Open Bidding auction to remove the so-called "last look" of AdX over other exchanges that participated in Open Bidding.[955] To accomplish that, Google *first* conducted a second-price auction among its AdX bidders with the same floor price it used before Open Bidding, and *then*

[953] *See* Sarah Sluis, "Google Removes Its 'Last-Look' Auction Advantage," AdExchanger (Mar. 31, 2017), https://www.adexchanger.com/platforms/google-removes-last-look-auction-advantage/ ("During a Google forum late last year, the biggest concern voiced by publishers and exchanges centered on this last-look advantage.").

[954] The main difference is that the value CPMs of remnant line items were not really bids for the impression—so that the publisher could choose reports to influence the AdX "last look," as discussed in Section X—whereas the bids made by exchanges under Open Bidding were actual bids for the impression that would later be used as the basis of payments.

[955] "2018 Sellside Launches Revenue Evaluation" (Jul. 19, 2019), GOOG-DOJ-13226855, at tab "Q1Q2 '17 Launch News," cell R60.

compared the AdX auction's clearing price to the best Open Bidding exchange bid on a first-price basis.[956, 957] A consequence of this procedure is that, for an AdX bidder to win the impression, AdX would need to have *two* bids (or a bid and a floor price) higher than the best first-price bid from other exchanges in Open Bidding.[958] This design was used for Open Bidding's "open beta" version, through the general release in April 2018, until the transition to the Unified First Price Auction in 2019.[959]

486. By maintaining the second-price auction on AdX, this design of Open Bidding was bidder-truthful (as defined in Section III.C.3.a) for bidders on AdX. But because the second-price auction's clearing price was not optimized as a bid into the first-price Open Bidding auction, AdX bidders were disadvantaged. To illustrate this disadvantage, suppose that AdX received two bids for an impression, $5 and $1, and the best first-price bid from another exchange was $1.20 (coming from a bidder with value of, say, $2). The auction outcome is determined by comparing AdX's clearing price from its internal second-price auction (that is, the second-highest bid of $1) to the best Open Bidding exchange bid (that is, $1.20), resulting in the $1.20 bid winning the auction. In this case,

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[956] That is, the AdX clearing price (net of AdX revenue share) would be compared to the best bid from Open Bidding (net of Open Bidding revenue share). If the net AdX clearing price was larger, the AdX bidder would win the impression and the publisher would receive the AdX clearing price; otherwise, the Open Bidding bidder would win and pay its bid.

[957] *See* Presentation, "Exchange Bidding 'Last Look' leak" (Apr. 5, 2017), GOOG-DOJ-14024199, at -201 ("AdX and all EBDA SSPs run auctions and submit their bids[.] All bids are compared in a first price auction[.] SSPs are not acting as AdX 2nd price[.] Example[:] AdX highest bid- $5[.] AdX second bid- $2[.] SSP - 4$[.] Result: SSP wins at $4").

[958] If there were no bids from AdX bidders above the floor price and that floor price was set by a non-guaranteed line item or the EDA price, AdX would submit the floor price as a bid into the first-price auction between exchanges, and would allocate the impression to the relevant non-guaranteed line item or direct deal if that bid won the Open Bidding auction.

[959] *See* Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 26. Open Bidding's open beta launch was in May 2017. *See* Launch Details Spreadsheet, Launch 181852 (Aug. 31, 2023), GOOG-AT-MDL-009644401, at cell C2.

however, the AdX bidder willing to pay $5 is disadvantaged: it loses the auction despite having the highest value and bidding more than any other bidder. The publisher may also miss out on possible revenue improvements, because the highest bidder's willingness to pay much more has no effect on the final price in the Open Bidding auction.

487. A Google document summarized this problem as follows: "The clearing price from the internal AdX 2P auction[] may not always be competitive in the unified auction."[960] Internally, Google described this complicated auction design as "chaos."[961]

488. Despite these flaws, an internal Google presentation showed that the launch of Open Bidding resulted in approximately [redacted] increased revenue for publishers and was approximately [redacted] for Google.[962] Impressions sold by Open Bidding did not displace impressions sold by header bidding: instead, a Google analysis found that the share of impressions allocated to header bidding increased somewhat after the launch of Open Bidding.[963] Google's data showed that the main effect of Open Bidding was to replace impressions sold by *static* remnant bids with impressions sold by *real-time* bids in Open Bidding.[964] Having more impressions allocated using real-time bids improved platform thickness and efficiency. The introduction of Open Bidding was also celebrated

[960] Product Requirements Doc, "PRD: Unified 1P auction and Pricing rules" (Jul. 25, 2018), GOOG-DOJ-03998505, at -505.

[961] Presentation, "Welcome to Exchange Partnerships Executive Conference 2019" (May 2019), GOOG-DOJ-13501237, at -243.

[962] Presentation, "Exchange Bidding Sell Side Update" (Jun. 14, 2018), GOOG-DOJ-11790760, at -761 ("[Open Bidding] was expected to [redacted]"), -771.

[963] Presentation, "Exchange Bidding Sell Side Update" (Jun. 14, 2018), GOOG-DOJ-11790760, at -775 ("Median HB Win Rate per publisher [redacted]

[964] *See* Presentation, "Exchange Bidding Sell Side Update" (Jun. 14, 2018), GOOG-DOJ-11790760, at -775 ("Publishers are moving from a waterfall based approach to RTB (EB and Header Bidding)").

by some competing exchanges, with OpenX reporting that "[e]xisting OpenX publisher partners who enabled [Open Bidding] through the OpenX Exchange experienced an average 48% increase in programmatic revenue from OpenX."[965]

489. Following the release of Open Bidding (which was still known externally as Exchange Bidding), Google launched Network Bidding in 2019.[966] Network Bidding offered "mega [ad] networks"[967] an additional alternative to traditional waterfall mediation, with AppLovin being the first network to participate.[968] Like Open Bidding, Network Bidding charged participants a [redacted] revenue share.[969] Bids from Network Bidding buyers competed in real-time against Open Bidding exchanges and AdX on a first-price basis.[970] If an ad network previously competed for inventory via static prices or the waterfall, I would expect real-time bids and the transition to Network Bidding to increase publisher revenues by the same logic that applies to Open Bidding above.

[965] OpenX, "Google & OpenX Release Study Showing Publisher Partners Experience 48% Revenue Lift Through Google Exchange Bidding Collaboration" (Feb. 15, 2018), https://www.openx.com/press-releases/google-openx-revenue-lift/.

[966] *See* Email from [redacted], "Re: AppLovin Open Bidding Live with First Beta Publisher!" (Jan. 10, 2019), GOOG-DOJ-AT-00849635, at -636 ("[W]e have AppLovin fully launched as our first Open Bidding network!").

[967] *See* Presentation, "FAN DFP & AdMob (Jedi 4 Networks) Opportunity" (Apr. 2017), GOOG-DOJ-09875881, at -889 ("Jedi for Networks * (NEW) Intended for [...] [redacted]").

[968] *See* Email from [redacted] l., "Re: AppLovin Open Bidding Live with First Beta Publisher!" (Jan. 10, 2019), GOOG-DOJ-AT-00849635, at -636 ("[W]e have AppLovin fully launched as our first Open Bidding network!").

[969] *See* Presentation, "Jedi For Networks" (Jan. 31, 2018), GOOG-DOJ-15226550, at -565 (table showing revenue shares for categories of demand and inventory, showing that Network Bidding had a [redacted] revenue share).

[970] *See* Product Requirements Doc, "PRD: Unified 1P auction and Pricing rules" (Jul. 25, 2018), GOOG-DOJ-03998505, at -505 ("AdX buyers (GDN, DBM and 3P RTB) submit second-price bids to AdX, meaning they compete in a 2P auction in which the winner pays the second-highest eligible bid or the price floor. With the introduction of Jedi (Exchange Bidding and Network Bidding), the winner of the second-price AdX auction submits the clearing price of the second price auction to another auction (unified auction), where it competes with EB and NB bids on a first price basis.").

3. Google's Transition to the Unified First Price Auction Further Increased Efficiency

490. To understand why Google transitioned to a first-price auction, consider the requirements it faced. Suppose that the ad allocation process must (1) employ an "auction of auctions" in which the winning exchange is the one with the highest auction clearing price; (2) ensure that the clearing price in its auction depends only on the bids in its auction and not on the bids in any other auction (avoiding what others have called a "last look"); and (3) ensure that the highest net bid by any advertiser wins. Applying simple logic to these three requirements implies that the clearing prices in each exchange can depend only on the highest bid in that exchange's auction, and not on the second-highest bid, so the requirements cannot be satisfied if any exchange uses a second-price auction. To achieve these requirements, *all participating exchanges—including AdX—must use first-price auctions*. For AdX, the switch from its historic second-price auction to a first-price auction was a major change that would present new challenges for all its bidders, because they would need to adapt their bidding procedures to the new first-price auction rule.

491. After the eventual migration to the Unified First Price Auction was completed in September 2019, all bidders—including AdX bidders, header bidders, and non-Google exchanges using Open Bidding—competed on the same first-price basis, with the highest bidder paying its bid.[971] This change eliminated the inefficiencies and confusions caused by differences in auction formats, and removed the so-called "last look" over header bidding. It reduced transaction costs both for both bidders (who no longer needed to bid

[971] Comms Doc, "Ad Manager Unified 1st Price Auction" (Sep. 27, 2019), GOOG-DOJ-09714662, at -663 ("After the transition is complete, all publisher traffic is on 1st auction").

differently in different exchanges) and publishers (who no longer needed to inflate header bids to set value CPMs for a second-price auction).

492. To ease the transition for its bidder customers to the new auction rules, Google Ads and DV360 introduced new programs to optimize their bids into the Unified First Price Auction. As discussed in Section IV.C.1.c, Alchemist optimized bids into the UFPA for Google Ads advertisers, while using threshold pricing to determine payments by advertisers.[972] The threshold prices made the Google Ads internal auction bidder-truthful for those advertisers. On DV360, Google determined bids into the UFPA on behalf of its advertisers (unless the advertiser opted out) using a bid optimization program similar to earlier versions of Poirot.[973] A winning DV360 advertiser would be charged its bid (plus any applicable platform fees).[974] This payment rule also incentivizes truthful reporting of campaign parameters so long as DV360 is trusted to determine the optimal bid shading factors on behalf of its advertisers. In combination, these programs maintained the simplicity of Google's buy-side tools, while allowing the bids from different demand-side platforms to be directly and simply compared.

493. Since the transition to the UFPA, Google has provided real-time bidders—including Authorized Buyers and Open Bidders—with historical auction information to allow

[972] Recall that this means that a Google Ads advertiser pays the lowest value it could have reported while still winning the impression. *See* Design Doc, "The Alchemist (AKA First Price Bernanke)" (Mar. 2019), GOOG-DOJ-14550102, at -103 to -104 (providing details on how the payment is calculated); Declaration of [redacted] (Aug. 5, 2023), GOOG-AT-MDL-008842383, at ¶ 22.

[973] Declaration of [redacted] (Aug. 5, 2023), GOOG-AT-MDL-008842383, at ¶ 35 ("With the transition to a Unified First Price Auction, Google began providing minimum-bid-to-win data to buyers, and DV360 began to use that minimum-bid-to-win data to inform how Poirot would lower bids into AdX in order to optimize for expected advertiser surplus.").

[974] Or as otherwise agreed in the contract made between the advertiser and DV360, but this was the standard way advertisers were charged by DV360. *See* "ORDER FORM - DoubleClick Bid Manager Service" (Dec. 10, 2015), GOOG-DOJ-09457868, at -868 to -869.

non-Google buying tools to optimize their bids into the UFPA.[975] Among this information is the **minimum bid to win (MBTW)**: the smallest amount a bidder needs to bid to win an auction, holding all other bids in the auction fixed.[976] Google shares this MBTW data with *all* real-time bidders with which it shares a direct communication channel, including third-party DSPs and Open Bidding exchanges.[977]

494. In addition to sharing MBTW data with ad buyers, Google has also provided its publisher customers with auction data via Bid Data Transfer (BDT) files.[978] Early versions of these files were implemented prior to the UFPA, with the aim of providing publishers information about buyers' bids.[979] However, Google and its AdX customers had concerns about publishers' ability to access fields that allowed for buyers' losing bids to be matched to sensitive end-user information.[980] For example, [redacted] subjected Google to

[975] *See* Google, "2019 Google Ad Manager releases archive," Google Ad Manager Help (Jul. 1, 2019), https://support.google.com/admanager/answer/9197913?hl=en#expand&expand070119 ("Buyers currently have the ability to access feedback on prior bids they submitted into the auction […] As part of the transition to a first-price auction, buyers will gain access to a similar field (minimum_bid_to_win) that provides feedback on the minimum bid value necessary to have won a prior auction.").

[976] For the auction winner, this value is the larger of the runner-up bid and the floor price. For auction losers, the value is the larger of the highest bid and the floor price. *See* Presentation, "UPR/1P for Buyers gTech Resources" (Jun. 24, 2019), GOOG-DOJ-14039426, at -431.

[977] *See* Declaration of N. Korula (May 2, 2024), GOOG-AT-MDL-C-000017971, at ¶ 11 ("The Unified First-Price Auction sends the minimum-bid-to-win information to real-time bidders that directly bid into the Unified First-Price Auction (as long as their bid was not filtered from the auction), including all third-party exchanges that participate in Open Bidding and all bidders in Google's ad exchange.").

[978] *See* [redacted] (Jun. 28, 2024), GOOG-AT-MDL-C-000073682, at ¶ 11.

[979] [redacted] (Jun. 28, 2024), GOOG-AT-MDL-C-000073682, at ¶ 11 ("Prior to September 2019, Google allowed buyers to opt out of including information about their bids in BDT files."). *See also* Launch Details Spreadsheet, Launch 199259 (Aug. 29, 2023), GOOG-AT-MDL-009644182, at cells C2, C3 (noting launch date of 2017-9-5 for "Jedi Bid Data Transfer Beta").

[980] [redacted] (Jun. 28, 2024), GOOG-AT-MDL-C-000073682, at ¶ 13 ("The inclusion of information about a more complete set of bids raised two types of concerns within Google. First, there were concerns that a then-existing contract with an important Authorized Buyer prohibited Google from providing publishers with information about its bids in a format that could be joined with other Data Transfer report files. Second, there were privacy concerns that certain types of bid data could be tied to individual users if BDT files containing a more complete set of bids could be combined with other types of Data Transfer files.").

contractual restrictions that "disallow[] Google from sharing [redacted] losing bids tied to user identifiable information[.]"[981] Google addressed these privacy and contractual concerns by enabling buyers to opt out of sharing bid data with publishers, but that led to a significant portion of bids to be excluded from the datasets.[982] As Google later transitioned to the UFPA, it sought "to provide publishers more information about the new first-price auction by including a *complete* set of bids from all Authorized Buyers, Open Bidding buyers, Google Ads, and DV360."[983] With the "inten[tion] to provide publishers more information" in the move to the UFPA,[984] Google modified BDT files to prevent linking between losing bids and end-user data[985] while also "remov[ing] the

[981] Presentation, "1P Auction - Bid Data Transfer[:] Roll-out Plan" (Jul. 24, 2019), GOOG-DOJ-06882418, at -420 ("New Bid Data Transfer file, providing publishers with complete visibility into every single programmatic bid on every auction (all buyers on AdX + EB, remove buyer opt-out from bid sharing) ... but have since realized this is incompatible with existing contractual obligations to [redacted] has a contract clause that disallows Google from sharing [redacted] losing bids tied to user identifiable information[.]"); *see* Buyer Terms Agreement, "Google DoubleClick Ad Exchange Buyer Terms" (Apr. 8, 2014), GOOG-DOJ-15247796, at -796, -799 ("These Google DoubleClick Ad Exchange Buyer Terms ('Terms') are entered into by Google Inc. ('Google') and A9.com, Inc. ('Customer') [...] Customer Data will be deemed 'Confidential Information' of Customer. Notwithstanding the foregoing, (i) Google may disclose *non-User Identifiable* Customer Data to Partners if Google generally discloses similar data from other buyers to Partners in a substantially similar manner under the Program, (ii) Google may disclose *non-User Identifiable* Customer Data to report statistics about the Program if such data is in aggregate form and not identified or identifiable as Customer's or Advertiser's, and (iii) with respect to an auction for any impression for which Customer is the *winning bidder*, Google may disclose the User-Identifiable Customer Data related to Customer's bid request to the Partner on whose Publisher Property the Ad is served. If Google offers a new Program feature that discloses Customer Data to Partners, then within 30 days of a Customer request, Google will provide a demonstration or written description of the nature and extent of Customer Data being disclosed through that new Program feature.") (emphasis added). *See also* [redacted] (Jun. 28, 2024), GOOG-AT-MDL-C-000073682, at ¶ 13 ("First, there were concerns that a then-existing contract with an important Authorized Buyer prohibited Google from providing publishers with information about its bids in a format that could be joined with other Data Transfer report files.").

[982] *See* [redacted] GOOG-AT-MDL-C-000073682, at ¶ 11 ("For example, on August 31, 2019, approximately 70% of impressions and 50% of publisher revenue came from buyers that had opted out of having their information included in BDT files.").

[983] [redacted] GOOG-AT-MDL-C-000073682, at ¶ 12 (emphasis added).

[984] *See* [redacted] (Jun. 28, 2024), GOOG-AT-MDL-C-000073682, at ¶ 12.

[985] [redacted] (Jun. 28, 2024), GOOG-AT-MDL-C-000073682, at ¶ 13 ("The inclusion of information about a more complete set of bids raised two types of concerns within Google. First, there were concerns that a then-existing contract with an important Authorized Buyer prohibited Google from providing publishers with information about its bids in a format that could be joined with other Data Transfer report files. Second, there were privacy concerns that certain types of bid data could be tied to individual users if BDT files containing a more complete set of bids could be combined with other types of Data Transfer files. Because of these

option for bidders to opt out of including information about their bids[.]"[986] These combined changes ensured that Google fulfilled its contractual commitments, addressed the privacy concerns of its buyers, and also shared a more complete set of bids with its publisher customers.[987]

D. Responding to Plaintiffs' and Their Experts' Allegations

1. Plaintiffs Mischaracterize the Open Bidding Program

495. Plaintiffs allege that Open Bidding was devised to "maintain its exchange monopoly and exclude competition from exchanges,"[988] but Plaintiffs' allegations mischaracterize or do not account for relevant details of the Open Bidding program.

496. *First,* the Plaintiffs claim that Open Bidding "requir[es] publishers to route their inventory through AdX, even if they do not want to."[989] But this is incorrect. After Open Bidding, publishers could continue calling exchanges via header bidding. While Open Bidding and header bidding could function alongside one another, publishers also had the flexibility to fully opt out of Google's Open Bidding services.[990] Non-Google exchanges

two concerns, at the same time in September 2019 that Google updated BDT files to include information about a more complete set of bidders, Google also changed the 'KeyPart' field in BDT files to be unique to those files and not joinable with other Data Transfer report files, and Google removed other fields that otherwise could have been used to probabilistically join BDT files with other Data Transfer report files.").

[986] [redacted] (Jun. 28, 2024), GOOG-AT-MDL-C-000073682, at ¶ 12 ("When Google transitioned to a Unified First Price Auction in September 2019, Google removed the option for bidders to opt out of including information about their bids in BDT files.").

[987] *See* [redacted] (Jun. 28, 2024), GOOG-AT-MDL-C-000073682, at ¶ 13.

[988] Fourth Amended Complaint ¶ 367.

[989] Fourth Amended Complaint ¶ 370.

[990] *See* Happy Das, "Header Bidding vs Open Bidding – What Should You Know!," headerbidding.co Blog (Feb. 23, 2024), https://headerbidding.co/header-bidding-vs-open-bidding/ ("There are pros and cons to both Open Bidding and header bidding, so the right solution will ultimately depend on what you're looking for. If you can't seem to decide between the two, consider them both as options, as they can ultimately coexist within your ad server. Fortunately, you're never obligated to choose one over the other—make the call that works best for your setup, even

could also choose not to participate in Open Bidding, and publishers could still access those exchanges through header bidding. For these reasons, Professor Weinberg's "[c]omparison of header bidding to Exchange Bidding" is not relevant.[991] A publisher need not select between header bidding or Open Bidding. It can always opt to use header bidding instead of or alongside Open Bidding—whichever it finds more profitable.

497. *Second,* Plaintiffs argue that "[h]eader bidding lets each exchange access a cookie on the user's page, which permits an exchange to recapture some information about the user's identity," while "Exchange Bidding diminishes the ability of non-Google exchanges […] to identify users associated with publishers' heterogeneous inventory."[992] However, Google provided Open Bidding partners with its Cookie Matching Service that enabled exchanges to "match [...] their cookie[s]" for many impressions.[993] Additionally, publishers and exchanges could continue to use header bidding, leaving any existing implementation of end-user identification unchanged.

498. *Third*, Plaintiffs express concerns about the Open Bidding revenue share, but they fail to explain why a [redacted] revenue share is too much to charge for Google's Open Bidding

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if it's called something different. You can always change course in the future if you find yourself wishing you had picked a different solution from the get-go."). *See also* Ad.Plus, "Header Bidding vs Open Bidding," Ad.Plus Blog (Jan. 6, 2023), https://blog.ad.plus/header-bidding-vs-open-bidding/ ("Google Open Bidding is often used in conjunction with header bidding, which allows multiple demand sources to bid on ad inventory simultaneously. It is intended to be a more efficient way for publishers to monetize their ad inventory, as they can potentially receive higher bids from a wider pool of buyers.").

[991] *See* Expert Report of M. Weinberg (Jun. 7, 2024), at Section V.B.2.

[992] Fourth Amended Complaint ¶ 367.

[993] Google for Developers, "Cookie Matching," Real-time Bidding (accessed Jul. 17, 2024), https://developers.google.com/authorized-buyers/rtb/cookie-guide ("Open Bidding allows exchanges to use bidder initiated [...] and Google initiated [...] cookie matching workflows, to match a Google User ID with their cookie."). *See also* [redacted] (Redacted) (Sep. 29, 2023), GOOG-AT-MDL-C-000016753, at ¶ 16.

services.[994] For publishers, these services included reporting, payment processing, and integration with non-Google exchanges; for exchanges, they included real-time processing of the huge number of bids they submitted on each impression.[995] Moreover, other non-Google header bidding services charge fees. For example, Amazon's UAM deducts a 10% fee from bids into its header bidding service.[996] Internally, Google employees assessed that other exchange bidding tools charged revenue shares of between [redacted][997] Publishers who wished to avoid the Open Bidding revenue share could choose to use header bidding instead.

499. *Fourth*, Plaintiffs claim that, "in operating Exchange Bidding, Google maintained visibility into the bids submitted by rival exchanges and used that information to inform its own trade decisions" and "could win an auction for a publisher's inventory even over another exchange's higher bid."[998] These statements are incorrect in three ways.

i. Before the 2019 transition to a Unified First-Price Auction, neither Google Ads nor DV360 ever used bids from Open Bidding or header bidding to adjust the amount of a bid on the same impression.[999]

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[994] Fourth Amended Complaint ¶ 369.

[995] Comms Doc, "Open Bidding on Ad Manager (fka Exchange Bidding)" (Aug. 2019), GOOG-DOJ-15389438, at -438 ("Easy to set up, view/analyze reports and unified payments […] Allows exchanges to respond to RTB call-outs […] Provides integrated reporting and billing for exchange bidding transactions won by 3rd party exchanges").

[996] *See* Amazon, "Unified Ad Marketplace," Amazon Publisher Services (accessed Sep. 12, 2023), https://aps.amazon.com/aps/unified-ad-marketplace/index.html ("UAM charges a 10% transaction fee from SSP and Amazon bid prices prior to conducting a first price auction.").

[997] [redacted] (Mar. 9, 2021), GOOG-DOJ-AT-01502155, at -155 [redacted] .").

[998] Fourth Amended Complaint ¶ 371.

[999] Even if the floor price faced by Google Ads or DV360 was set by a non-Google bidder (such as in header bidding or in the initial release of Open Bidding), neither Google Ads nor DV360 used it to adjust their bids. *See* [redacted] (May 01, 2024), GOOG-AT-MDL-C-000017969, at ¶¶ 2-3 ("Before the conclusion of an [redacted] on

ii. Since March 2017—over one year before the general release of Open Bidding—AdX has not had a "last look" or "visibility into the bids" of Open Bidding exchanges,[1000] and the transition to the Unified First-Price Auction eliminated any so-called "last look" over bids from header bidding exchanges.

iii. Since the general launch of Open Bidding, the exchange with the highest bid received under Open Bidding (net of the appropriate revenue share) was awarded the impression.[1001]

2. Open Bidding Did Not "Foreclose" Competition from Header Bidding or Other Ad Exchanges

500. Plaintiffs claim that Google's introduction of Open Bidding "successfully forecloses competition from header bidding and in the exchange market,"[1002] but external data reported by eMarketer on the top 1,000 US publishers (reproduced as Figure 15 below) suggests that the proportion of all publishers using header bidding continued to grow after Open Bidding launched in 2018. This is consistent with Google's analysis of its Open Bidding program, which suggested that many publishers increasingly adopted

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for an ad impression, Google Ad Manager has never provided Google Ads or DV360 with any bids that AdX or Open Bidding received from non-Google ad exchanges or non-Google buy-side tools in that auction. Before Google Ad Manager transitioned to a Unified First-Price Auction in 2019, Google Ads and DV360 never used a floor price in an auction for an ad impression to adjust the bid values that they would submit for that same ad impression.").

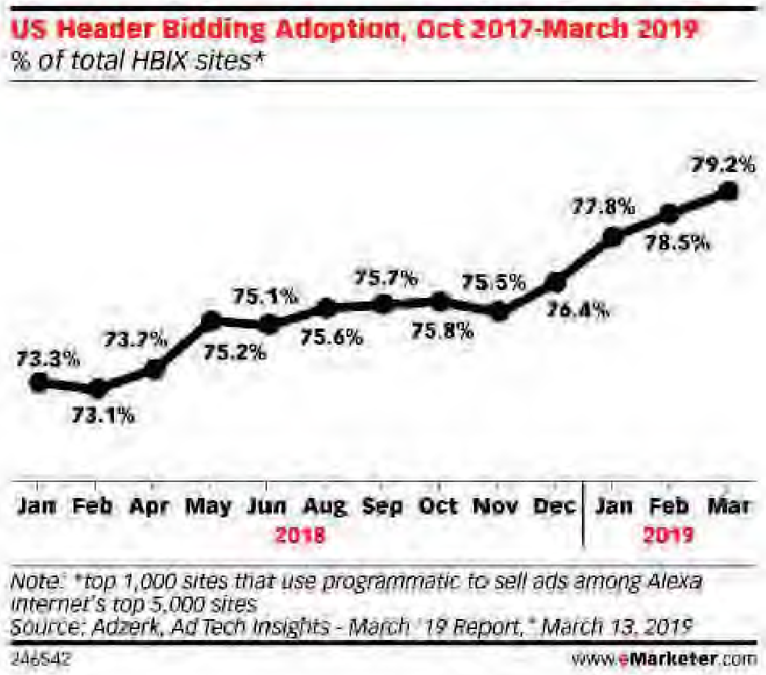
[1000] "2018 Sellside Launches Revenue Evaluation" (Jul. 19, 2019), GOOG-DOJ-13226855, at tab "Q1Q2 '17 Launch News," cells B60, R60 (noting launch date of 3/29/17 for "Remove Last Look for Demand Syndication Auction").

[1001] *See* Launch Document, "Launch Doc: Adx Auction in Post Revshare Space" (Jan. 31, 2017), GOOG-DOJ-AT-02425378, at -378 ("In the post-revshare auction, we pick a buyer that maximizes ability to pay after Google's revshare has been discounted."); Launch Details Spreadsheet, Launch 181133 (Aug. 26, 2023), GOOG-AT-MDL-009644157, at cell C2 (noting launch date of 2017-3-2).

[1002] Fourth Amended Complaint ¶ 372.

allocation methods incorporating more real-time bids after the introduction of Open Bidding (using either header bidding or Open Bidding or a combination of the two).[1003]

Figure 15: External data from eMarketer suggests that the adoption of header bidding by publishers was not negatively impacted by introduction of Open Bidding.[1004]



501. Data from Google's Header Bidding Monitor dataset also suggests that publishers continued utilizing header bidding after adopting Open Bidding. According to the dataset, as of March 2023, [redacted] North American publishers using Google Ad Manager used Open Bidding for some impressions. Of those [redacted] publishers

[1003] Presentation, "Exchange Bidding Sell Side Update" (Jun. 14, 2018), GOOG-DOJ-11790760, at -775 ("Publishers are moving from a waterfall based approach to RTB (EB and Header Bidding)").

[1004] *See* Ross Benes, "Five Charts: The State of Header Bidding," eMarketer Insider Intelligence (May 30, 2019), https://www.insiderintelligence.com/content/five-charts-the-state-of-header-bidding.

using Open Bidding, [redacted]) sold impressions via channels that Google attributed to header bidding.[1005]

502. Open Bidding also made it *easier* for publishers to partner with competing exchanges, allowing exchanges like OpenX and Index Exchange to expand the number of impressions they could serve.[1006] Simplifying payment processing for publishers was seen as one of the key advantages of Open Bidding.[1007] The reduced costs of integrating and processing bids from the non-Google exchanges participating in Open Bidding encouraged more publishers to offer impressions to multiple exchanges, which benefited those exchanges.[1008]

[1005] This statistic is based on [redacted], *see* GOOG-AT-EDVA-DATA-000000006, grouped by month, with Open Bidding entries taken to be those with a transaction_type of "EBDA" or numbers 9-11, and header bidding entries taken to be those with an [redacted] *See* [redacted] Appendix A (Oct. 6, 2023), GOOG-AT-MDL-C-000012826, at -874. Publishers are grouped by their network_id and ranked according to the number of queries matched in the dataset. Code for this result can be found in code/hb_monitor_ob_freq.py in my supporting materials, and the output is saved in code/logs/hb_monitor_ob_freq.txt.

[1006] *See* Presentation, "Exchange Bidding Sell Side Update" (Jun. 14, 2018), GOOG-DOJ-11790760, at -761 ("[redacted] […]").

[1007] *See* Sagar Bhatia, "Google Open Bidding (OB) Explained," AdSparc (Apr. 12, 2022), https://adsparc.com/google-open-bidding-explained/ ("Here are some advantages of Google Open Bidding over header bidding: Payment Management: One of the critical advantages of using OB over header bidding is payment management. For OB, payments are sent directly to publishers via Google, whereas for header bidding, payments are managed by vendors or the publishers themselves […]").

[1008] *See* Presentation, "Exchange Bidding Sell Side Update" (Jun. 14, 2018), GOOG-DOJ-11790760, at -775 (Table, [redacted]).

3. Plaintiffs' and Their Experts' Incorrectly Assert that "Minimum Bid to Win" Data Disadvantages Header Bidders

a) Sharing Minimum Bid to Win Does Not "Recapture" a "Last Look Advantage"

503. Plaintiffs allege that Google and Open Bidding exchanges could use MBTW data "to adjust their future bidding strategy to continue trading ahead of exchanges returning bids through header bidding and underpaying for publishers' impressions"[1009] and that this data allowed Google to "recapture the advantages it had under Last Look."[1010] Plaintiffs' experts seem to agree, with Professor Pathak writing that, "although Google removed its Last Look advantage over Header Bidding from the unified auction, Google introduced a program with a similar effect by sharing 'Minimum Bid to Win' data with AdX and Exchange Bidding buyers and not Header Bidding buyers."[1011] These claims are incorrect.

504. *First,* there is no "advantage" to "recapture" under "Last Look."[1012] As I have explained in Section X, taking proper account of bidder and publisher incentives, the so-called "last

[1009] Fourth Amended Complaint ¶ 380 ("Specifically, in 2019, DFP began sharing sensitive pricing information derived from publishers' sensitive clearing auction records (which Google called "Minimum Bid to Win" data) with exchanges in Exchange Bidding. Google's AdX exchange and other exchanges in Exchange Bidding use this data to adjust their future bidding strategy to continue trading ahead of exchanges returning bids through header bidding and underpaying for publishers' impressions.").

[1010] Fourth Amended Complaint ¶ 381 ("Google compounded this Exchange Bidding advantage with a new secret bid optimization scheme that allowed Google to recapture the advantages it had under Last Look. The new scheme uses information about publishers' ad server user IDs and rival exchanges' bids to accurately predict the amount to bid, effectively permitting Google to re-engineer the ability of AdX and Google's ad buying tools to trade ahead of rivals exchanges in Exchange Bidding. As a Google planning document outlines: 'If we knew our competitor's bid exactly, we can simply bid a cent above that[.] But we don't have this information before the auction, so we need to predict [the] competitor's bid.'").

[1011] Expert Report of P. Pathak (Jun. 7, 2024), at ¶ 199 ("For instance, although Google removed its Last Look advantage over Header Bidding from the unified auction, Google introduced a program with a similar effect by sharing 'Minimum Bid to Win' data with AdX and Exchange Bidding buyers and not Header Bidding buyers. Minimum Bid to Win data effectively recreates Last Look, because AdX and Exchange Bidding buyers can use the information from Minimum Bid to Win on their next auctions, while Header Bidding buyers cannot.").

[1012] Fourth Amended Complaint ¶ 381.

look" did not inherently advantage AdX and other Open Bidding exchanges. Moreover, any suggestion that AdX or Open Bidding buyers could "peek" at a competitors' bids before submitting their bids at the time of the UFPA is wrong.[1013] To the contrary, the MBTW was shared *after* the auction's conclusion.[1014]

505. *Second*, any suggestion that using MBTW information is nefarious and somehow enabled AdX or other Open Bidding buyers to exactly predict header bids and "displace" their trades by "a penny" is wrong. In first-price auctions, bidders' competitors vary their participation and bids from impression to impression—even for impressions from the same end user—o MBTW information does not enable a bidder to "know [a] competitor's bid exactly"[1015] and "displace" them "by a penny."[1016] It is widely understood that optimal bidding in a first-price auction requires bidders to make

[1013] Fourth Amended Complaint ¶¶ 378-81 ("Starting with the official launch of Exchange Bidding in June of 2017, Google sought to lure exchanges away from header bidding by sharing its Last Look advantage with other exchanges participating in Exchange Bidding. These exchanges could now also peek at header bidding net bids and displace their trades by a penny [...] Several years later, [...] DFP began sharing sensitive pricing information derived from publishers' sensitive clearing auction records (which Google called 'Minimum Bid to Win' data) with exchanges in Exchange Bidding. [...] Google compounded this Exchange Bidding advantage with a new secret bid optimization scheme that allowed Google to recapture the advantages it had under Last Look. The new scheme uses information [...] to accurately predict the amount to bid, effectively permitting Google to re-engineer the ability of AdX and Google's ad buying tools to trade ahead of rivals exchanges in Exchange Bidding.").

[1014] Declaration of N. Korula (May 2, 2024), GOOG-AT-MDL-C-000017971, at ¶ 10 ("The minimum-bid-to-win is information that the Unified First-Price Auction sends after a given auction has ended.").

[1015] Fourth Amended Complaint ¶ 381 ("The new scheme uses information about publishers' ad server user IDs and rival exchanges' bids to accurately predict the amount to bid, effectively permitting Google to re-engineer the ability of AdX and Google's ad buying tools to trade ahead of rivals exchanges in Exchange Bidding. As a Google planning document outlines: 'If we knew our competitor's bid exactly, we can simply bid a cent above that[.] But we don't have this information before the auction, so we need to predict [the] competitor's bid.'").

[1016] Fourth Amended Complaint ¶¶ 378-81 ("Starting with the official launch of Exchange Bidding in June of 2017, Google sought to lure exchanges away from header bidding by sharing its Last Look advantage with other exchanges participating in Exchange Bidding. These exchanges could now also peek at header bidding net bids and displace their trades by a penny. Several years later, [...] DFP began sharing sensitive pricing information derived from publishers' sensitive clearing auction records (which Google called "Minimum Bid to Win" data) with exchanges in Exchange Bidding. [...] Google compounded this Exchange Bidding advantage with a new secret bid optimization scheme that allowed Google to recapture the advantages it had under Last Look. The new scheme uses information [...] to accurately predict the amount to bid, effectively permitting Google to re-engineer the ability of AdX and Google's ad buying tools to trade ahead of rivals exchanges in Exchange Bidding.").

probabilistic assessments of competitors' likely bids[1017] to determine their own bids, and Google made this easier for its customers by providing feedback from past auctions.

b) Plaintiffs' and Their Experts' Arguments are Ahistorical and Fail to Account for Participants' Alternatives

506. Plaintiffs' and their experts' arguments suggest that not "sharing" MBTW data with "Header Bidding buyers" disadvantaged them.[1018] However, this argument overlooks the technological limitations of "sharing" MBTW data with header bidding exchanges, ignores the alternative methods available for header bidding buyers to obtain this data, and overstates the unique importance of MBTW data.

507. As a publisher-configured technology, header bidding did not provide GAM with a direct communication channel to header bidding exchanges. As noted by a Google engineer, "[h]istorically, there was no basis on which this information could be sent by Ad Manager to header bidders because there is no server-to-server connection between Ad Manager and such bidders[.]"[1019] Instead, GAM enabled publishers to obtain a copy of MBTW information, which they could share directly with header bidding exchanges.[1020]

[1017] *See, e.g.*, Vickrey, W. (1961). Counterspeculation, auctions, and competitive sealed tenders. *Journal of Finance*, *16*(1), 8-37, at 21 ("In the top-price method of negotiation, as in the Dutch auction, bidders, in order to maximize their expectation of profit, must concern themselves not only with their own appraisal of the article but also with their estimate of the value that others will place on it and their expectation of the bidding strategy that others will follow. This involves a considerable amount of appraisal of the market situation as a whole[.]").

[1018] *See, e.g.*, Expert Report of P. Pathak (Jun. 7, 2024), at ¶ 199 ("Google introduced a program [... that] shar[ed] 'Minimum Bid to Win' data with AdX and Exchange Bidding buyers and not Header Bidding buyers.").

[1019] Declaration of N. Korula (May 2, 2024), GOOG-AT-MDL-C-000017971, at ¶ 12.

[1020] Declaration of N. Korula (May 2, 2024), GOOG-AT-MDL-C-000017971, at ¶ 12 ("Historically, there was no basis on which this information could be sent by Ad Manager to header bidders because there is no server-to-server connection between Ad Manager and such bidders and Ad Manager does not know the identify of these exchanges (although publishers could pass that information along to header bidders)."); Internal Briefing, "Briefing: News Corp Unified Pricing Floors Discussion" (Apr. 18, 2019), GOOG-DOJ-AT-00045716, at -721 ("If you use HB, you

508. There were also additional methods for header bidding buyers to obtain MBTW data:

a. *Open Bidding.* Header bidding exchanges can acquire MBTW information by submitting bids into Open Bidding.[1021] If the exchange wishes to transact impressions only through header bidding, it can do that and still receive MBTW information by submitting lower bids through Open Bidding.

b. *Multi-homing DSPs.* Plaintiffs incorrectly presume that *exchanges* submit bids, rather than *DSPs*. When DSPs submit bids, they frequently multi-home, submitting bids into numerous exchanges on the same impression opportunity.[1022] A DSP that bids into both a header bidding exchange and AdX receives the MBTW from GAM.[1023] The DSP is not required to purchase any additional impressions through AdX to acquire this information; it can bid lower into AdX as a means to receive MBTW information.

c. *Google Ad Manager.* In June 2022, Google introduced a feature enabling "header bidders who participate in the Ad Manager auction for web inventory" to receive MBTW information directly from GAM.[1024]

can use Data Transfer [files], where you can see all of the bids and the winning bid, and you can share this with anyone you like.").

[1021] *See* Comms Doc, "Header bidding in yield groups" (May 3, 2022), GOOG-AT-MDL-006196134, at -136 ("Currently [minimum bid to win] information is shared by Ad Manager - after an auction is run - with any Authorized Buyers and Open Bidders that submitted a bid in that auction.").

[1022] *See, e.g.*, [redacted]

[1023] Declaration of N. Korula (May 2, 2024), GOOG-AT-MDL-C-000017971, at ¶ 11 ("The Unified First-Price Auction sends the minimum-bid-to-win information to real-time bidders that directly bid into the Unified First-Price Auction (as long as their bid was not filtered from the auction), including all third-party exchanges that participate in Open Bidding and all bidders in Google's ad exchange.").

[1024] Declaration of N. Korula (May 2, 2024), GOOG-AT-MDL-C-000017971, at ¶ 12. *See also* Comms Doc, "Header bidding in yield groups" (May 3, 2022), GOOG-AT-MDL-006196134, at -136 ("This feature allows header bidding

509. In addition to overlooking all the ways in which header bidding buyers could access MBTW data, Plaintiffs and their experts significantly overstate the uniqueness of that data. Buyers without access to MBTW data could use other forms of feedback to effectively optimize their bids into first-price auctions. For example, such a buyer could experiment to learn optimal bids for the UFPA, as DV360 did for non-Google exchanges under Poirot (see Section VII).

4. Plaintiffs' and Their Experts' Bid Data "Redaction" Allegations Are Historically Incomplete and Fail to Account for Publishers' Alternatives

510. Plaintiffs and their experts claim that, in 2018, Google began redacting information from data files that it provided publishers, "crippl[ing] publishers' ability to measure the success of rival exchanges in header bidding[.]"[1025]

511. *First,* Plaintiffs' and their experts' description is historically incomplete and omits various contractual and privacy considerations. As I summarize in Section XIII.C.3, Google "intended to provide publishers [with] more information about the new first-price auction by including a complete set of bids from all Authorized Buyers, Open Bidding buyers, Google Ads, and DV360"[1026] as "approximately [redacted] and [redacted]

partners to receive [minimum bid to win] information, representing the minimum bid value necessary to have won an auction.").

[1025] Fourth Amended Complaint, Section VII.D.3.iii ("Google cripples publishers' ability to measure the success of rival exchanges in header bidding (2018 to present)."). *See also* Expert Report of P. Pathak (Jun. 7, 2024), at ¶ 150 ("The redaction of the DT protected AdX against the threat of Header Bidding because it removed publishers' ability to measure Header Bidding results and effectively target users."); Expert Report of J. Gans (Jun. 7, 2024), at ¶¶ 683, 685 ("In short, by changing the way that KeyPart was generated (or 're-encoding' it), Google removed the ability for publishers to match DT files together [...] By redacting these fields, Google prevented publishers from knowing relevant identifying information about auction winners.").

[1026] [redacted] (Jun. 28, 2024), GOOG-AT-MDL-C-000073682, at ¶ 12.

publisher revenue came from buyers that had opted out" at the time.[1027] Before Google could provide its publisher customers with "a more complete set of bids," it needed to resolve additional privacy and contractual concerns.[1028] Ultimately, modifying certain fields in the BDT files did just that, enabling Google to securely share bid information of more buyers.[1029]

512. Professor Gans disregards the historical context of these changes, undermining his conclusion that "Google's claim that it redacted data based on privacy concerns is pretextual" and that the "sole intent [...] was to remove the ability of publishers to join these files together and gain insights about their businesses and performance across various exchanges."[1030] Instead, he attempts to support his conclusion by quoting a single document[1031] that states, "We want to prevent a publisher being able to determine 'these

[1027] [redacted] (Jun. 28, 2024), GOOG-AT-MDL-C-000073682, at ¶ 11.

[1028] *See* [redacted] (Jun. 28, 2024), GOOG-AT-MDL-C-000073682, at ¶ 13.

[1029] *See* [redacted] (Jun. 28, 2024), GOOG-AT-MDL-C-000073682, at ¶ 13 ("The inclusion of information about a more complete set of bids raised two types of concerns within Google. First, there were concerns that a then-existing contract with an important Authorized Buyer prohibited Google from providing publishers with information about its bids in a format that could be joined with other Data Transfer report files. Second, there were privacy concerns that certain types of bid data could be tied to individual users if BDT files containing a more complete set of bids could be combined with other types of Data Transfer files. Because of these two concerns, at the same time in September 2019 that Google updated BDT files to include information about a more complete set of bidders, Google also changed the 'KeyPart' field in BDT files to be unique to those files and not joinable with other Data Transfer report files, and Google removed other fields that otherwise could have been used to probabilistically join BDT files with other Data Transfer report files.").

[1030] *See* Expert Report of [redacted] (Jun. 7, 2024), at Section VII.D.2 ("Google's claim that it redacted data based on privacy concerns is pretextual"), ¶ 689 ("Google's sole intent in making the changes to the DT files was to remove the ability of publishers to join these files together and gain insights about their businesses and performance across various exchanges.").

[1031] *See* Expert Report of [redacted] (Jun. 7, 2024), at ¶ 690 ("In a 2019 document, Google employees discuss the changes made to DT files. To the question, 'Why do we redact and roun[d] data?' an employee explains, 'We want to prevent a publis[her to be] able to determine "these advertisers were will[ing to pay] this much for that user's impression.' Google's intent is, hence, to limit the amount of information publishers receive to prevent them from establishing advertisers' willingness to pay across competing exchanges.") (quoting GOOG-NE-04599495, at -495, GOOG-DOJ-04602757, at -757).

advertisers were willing to pay this much for that user's impression.'"[1032] However, rather than providing support for his conclusion, that quote aligns with the historical context I have provided regarding Google's concerns for user privacy, its contractual commitments, and its desires to share the bids of more buyers with publishers. Indeed, the same document notes that Google's goal was to "to give publishers full transparency into the auction, while still protecting user privacy and the disclosure of proprietary data or user data that may be reflected in buyer's bids (for example, user interactions on their websites)."[1033]

513. *Second,* Plaintiffs' and their experts' allegations overstate the significance of the "redactions" to the BDT files.

a. After the "redactions," publishers could still utilize BDT files to infer whether bids from AdX or Open Bidding had lost to a competing line item, including a header bidding exchange. BDT files contain a field called "BidRejectionReason" which is set to "Outbid" if the bid "lost to another candidate in the auction or [a] competing ad server line item."[1034] Since header bidding was configured using ad server line items, a high-bid marked as "Outbid" could suggest that the

[1032] "1P Bid Data Transfer" (Aug. 9, 2019), GOOG-NE-04599495, at -495, GOOG-DOJ-04602757, at -757 ("We want to prevent a publisher being able to determine 'these advertisers were willing to pay this much for that user's impression.'").

[1033] "1P Bid Data Transfer" (Aug. 9, 2019), GOOG-NE-04599495, at -495, GOOG-DOJ-04602757, at -757 ("We want to give publishers full transparency into the auction, while still protecting user privacy and the disclosure of proprietary data or user data that may be reflected in buyer's bids (for example, user interactions on their websites).").

[1034] Google, "Bids data in Ad Manager Data Transfer (Beta)," Google Ad Manager Help (accessed Jul. 24, 2024), https://support.google.com/admanager/answer/7357436?hl=en ("BidRejectionReason[:] Reason the bid lost or did not participate in the auction. Possible values include: [...] 'Outbid': The bid lost to another candidate in the auction or competing ad server line item.").

impression was sold to a demand source represented by a line item with a high value CPM for the impression, such as a header bidding exchange.

b. Furthermore, publishers wishing to "evaluate the performance of exchanges in header bidding" had alternatives to acquire relevant information.[1035] For example, publishers could use A/B tests or experiments to evaluate how key performance indicators would change in the presence of certain header bidding exchanges.

514. BDT files have been a "beta" feature even as recently as 2024,[1036] and adoption by publishers has been [redacted] with [redacted] publishers subscribing to receive BDT files as of August 2019.[1037]

5. Professor Weinberg's "Last Look" Allegations Misrepresent the Auction Process

515. Professor Weinberg argues that "AdX and Exchange Bidding exchanges have a Last Look advantage over exchanges that participate in header bidding"[1038] and that Open Bidding "creates two tiers" with header bidding exchanges in the "lowest tier" and AdX and Open Bidding exchanges in the "top tier."[1039] However, Professor Weinberg

[1035] Fourth Amended Complaint ¶ 387.

[1036] Google, "Bids data in Ad Manager Data Transfer (Beta)," Google Ad Manager Help (accessed Jul. 24, 2024), https://support.google.com/admanager/answer/7357436?hl=en ("This feature is in Beta").

[1037] [redacted] (Jun. 28, 2024), GOOG-AT-MDL-C-000073682, at ¶ 17 ("[redacted].").

[1038] Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 161 ("AdX and Exchange Bidding exchanges have a Last Look advantage over exchanges that participate in header bidding, but do not have a Last Look advantage over each other, placing them in the top tier.").

[1039] Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 161 ("Therefore, one interpretation of Exchange Bidding is that it creates two tiers: Exchanges that participate in header bidding and exchanges that participate in Exchange Bidding together with AdX. Exchanges that participate in header bidding submit bids without seeing others' bids, and therefore have no Last Look advantage over anyone, and are vulnerable to AdX's and Exchange Bidding's Last Look advantage (placing them in the lowest tier). AdX and Exchange Bidding exchanges have a Last Look advantage over exchanges that participate in header bidding, but do not have a Last Look advantage over each other, placing them in the top tier.").

understates the possibility that a publisher could boost a header bid before it serves as the floor price in the ad auction to reduce or even reverse any purported "advantage."

516. As I discuss in Section X of this report, a publisher has incentives to increase ("boost" or "inflate") the header bids it submits in Open Bidding. When it does so, it increases the probability that the header bidding bid will win the impression, which makes it harder for a bidder on AdX or an Open Bidding exchange to win the impression. Depending on the extent of this bid inflation, there can be no "advantage" for AdX and Open Bidding exchanges. In fact, those exchanges could even be at a disadvantage. Despite acknowledging the possibility of header bid inflation, Professor Weinberg claims that "the impact [of a sophisticated publisher drastically inflating AdX's reserve specifically because of the Last Look advantage] is less clear-cut and would require a complicated analysis."[1040] But, the "impact" of boosting header bids *is* clear-cut. As I show in the technical notes in Section XV.F.1, in the example discussed by Professor Weinberg in his analysis of Open Bidding, a publisher that inflates header bids can achieve the same revenue as in a unified auction, while the bidders with the same distributions of values attain the same win rates and pay the same average prices. Consequently, there are no inherent tiers or "Last Look" advantages built into the Open Bidding design.

517. Professor Weinberg offers no evidence that publishers did not respond to their very clear incentives to boost header bids and no explanation as to why publishers would not

[1040] Expert Report of M. Weinberg (Jun. 7, 2024), at ft. 225 ("If a sophisticated publisher mildly inflates AdX's reserve specifically because of the Last Look advantage, or if advertisers bid similarly in these two cases, the same conclusions still qualitatively hold. If a sophisticated publisher drastically inflates AdX's reserve specifically because of the Last Look advantage, or advertisers drastically change their bids specifically due to AdX's Last Look advantage, the impact is less clear-cut and would require a complicated analysis weighing the benefits of Last Look versus the impact of an increased reserve and distinct bids.").

respond in that way. As I discuss in Section II.B.3 and Section X.D.2, there is evidence that publishers *did* boost header bids and there is good reason to expect that they would, given the importance of optimization for publisher returns and the simplicity of the logic involved.

518. Because AdX operated a second-price auction at the time, even if a publisher acts contrary to its incentives and does *not* boost header bids, it can still be better off under the so-called "last look" than under a scenario in which header bidders, AdX, and Open Bidding exchanges submit offers in a first-price auction without any "last look." If AdX submitted its clearing price without any "last look," the winning header bid would only need to exceed AdX's second-highest bid to win the impression. However, with "last look," the header bid must beat *both* the second-highest bid and the *highest* bid in AdX. This comparison would tend to encourage the header bidder to *increase* its bids in the auction with "last look" compared to the auction without, and that would increase publisher revenue. Indeed, in Section XV.G.2 of the Technical Notes, I demonstrate how the publisher revenues under "last look" are higher in a simple extension of Professor Weinberg's example, where the extension is that the exchange with "last look" receives bids from two bidders instead of just one.

XIV. UNIFIED PRICING RULES: PROTECTING ADVERTISERS FROM PRICE-FISHING BY PUBLISHERS USING EXCHANGE-DISCRIMINATORY FLOOR PRICES

A. Overview

519. In 2019, at the same time as its transition to a Unified First Price Auction (UFPA), Google introduced Unified Pricing Rules (UPR), which enabled publishers to use a single interface in Google Ad Manager to configure and manage floor prices that apply to all exchanges and demand sources.[1041] These floor prices could vary by properties of the impression and advertiser, but not by the identity of the exchange or the buying tool used by the advertiser.[1042]

520. UPR ensured that advertisers faced the same floor prices on all bidding channels in the UFPA. Before Google introduced the UFPA, publishers using GAM could improve both efficiency and revenue by setting different floor prices for bidders or demand sources

[1041] *See* Sam Cox, "Simplifying programmatic: first price auctions for Google Ad Manager," Google Ad Manager Blog (Mar. 6, 2019), https://blog.google/products/admanager/simplifying-programmatic-first-price-auctions-google-ad-manager/ ("[I]n the coming months we'll start to transition publisher inventory to a unified first price auction for Google Ad Manager."); Jason Bigler, "An update on first price auctions for Google Ad Manager," Google Ad Manager Blog (May 10, 2019), http://blog.google/products/admanager/update-first-price-auctions-google-ad-manager/ ("In addition to impacting how publishers are using floor price rules, changing to a first price auction in Ad Manager requires a change in how our rules function. […] That's why we released a new feature to all publishers globally, called unified pricing rules.").

[1042] *See* Comms Doc, "Ad Manager Unified 1st Price Auction" (Sep. 27, 2019), GOOG-DOJ-09714662, at -665 ("Unified Pricing rules will not support the following functionalities that were present in Open Auction pricing rules: Buyer-specific floors: ability to set different floors for different buyers/bidders for a given inventory targeting […] publishers will still be able to: Set per-advertiser floors in Unified Pricing rules"); Google, "Unified pricing rules," Google Ad Manager Help (Jun. 25, 2024), https://support.google.com/admanager/answer/9298008 ("Advertiser- and brand-specific pricing can be configured in unified pricing rules. They don't apply to remnant line items. Per-buyer and per-bidder pricing are not available."); Jason Bigler, "An update on first price auctions for Google Ad Manager," Google Ad Manager Blog (May 10, 2019), https://blog.google/products/admanager/update-first-price-auctions-google-ad-manager/ ("To maintain a fair and transparent auction, these rules will be applied to all partners equally, and cannot be set for individual buying platforms.").

depending on the order in which they were called. This important justification of setting different floor prices for different exchanges was eliminated in the UFPA, as discussed by Google engineers.[1043]

521. UPR benefited Google's buyer-customers. Although Google's Open Bidding had addressed some of the flaws of header bidding (as described in Section XIII), advertisers still faced the risk of self-competition, in which an advertiser partners with multiple DSPs or bids into multiple exchanges when those are competing for the same impression. In turn, publishers could exploit this advertiser multi-homing through a tactic known as **price-fishing**: by setting different floor prices for different exchanges, a publisher could increase its revenue at the expense of such advertisers. Internal documents suggest Google was concerned about the possibility of price-fishing after the transition to the UFPA,[1044] and UPR protected advertisers from such tactics. Facing a common floor price also simplified the bidding process for advertisers and DSPs, reducing the costs of evaluating the same impression that might be offered many times at different floor prices

[1043] *See* Email from [redacted], "Fwd: First-price & Removing pricing knobs" (May 11, 2019), GOOG-DOJ-06732979, at -980 ("We know that these knobs become less useful/impactful in the first-price auction. So even if we keep them they will become ineffective and the usage should trend down in the coming months.").

[1044] *See, e.g.*, Email from [redacted]., "Fwd: 1st Price Changes" (Jun. 10, 2019), GOOG-DOJ-12948968, at -969 ("Having granular control also incentivizes pubs to call the same demand source multiple times throughdifferent channels with different floor prices (eg. DBM is called through AdX, EB and HB with different floor prices), to effectively fish for the highest price.").

and formulating bid responses. Other online display advertising intermediaries have implemented similar rules requiring floor prices to be uniform across bidders.[1045]

522. UPR also benefited non-price-fishing publishers in two ways. *First*, it simplified the publisher's process of setting floor prices applying to both Google and non-Google buyers using Open Bidding. Instead of setting floor prices separately using each exchange's interface, a publisher needs to set just one UPR floor in GAM. *Second*, it mitigated an externality that would reduce the revenues of all publishers, arising when a multi-homing advertiser faced with price-fishing publishers finds it difficult to coordinate its many bids and is incentivized to reduce its bids or not bid at all on some impressions.

523. Plaintiffs and their experts fail to acknowledge the benefits of UPR to advertisers and publishers. A few months after the introduction of the UFPA and UPR, Google found that both total publisher revenues and the share of impressions allocated to non-Google exchanges increased.[1046] Post-launch experiments found that the combined effect of

[1045] *See, e.g.*, Meta, "Code of Conduct," Meta Audience Network (accessed Dec. 2, 2023), https://www.facebook.com/audiencenetwork/partner-program/code-of-conduct ("When a reserve price is applied as part of the auction, it should apply identically to all demand sources."). *See also* [redacted]

[1046] *See* Jason Bigler, "Rolling out first price auctions to Google Ad Manager partners," Google Ad Manager Blog (Sep. 5, 2019), https://blog.google/products/admanager/rolling-out-first-price-auctions-google-ad-manager-partners/ ("Over the last few months, we've been testing the performance of this change and the results show that on average, first price auctions have a neutral to positive impact on a publisher's total revenue—revenue from all their advertising sources—when compared to second price auctions. In addition, we found evidence that first price auctions have created a more competitive market, resulting in third parties (Demand Side Platforms and Ad Networks outside of Google) and indirect line items (like those from Header Bidding implementations) winning an increased share of impressions.").

UFPA and UPR was [redacted] on publisher revenues and [redacted] for non-Google DSPs buying via AdX.[1047]

524. Instead, Plaintiffs and their experts claim that "UPR reduced the ability of publishers to maximize revenue by setting different reserve prices for distinct demand sources and limited their ability to ensure high-quality advertisements."[1048] But differential floor prices for different advertisers are still allowed under UPR and may be used to manage yield and filter lower quality ads.[1049] In addition, AdX also provides publishers several ways in which to control the quality and type of ads that can be displayed.[1050] Finally, publishers can and do use a *more effective* tool than differential floor prices to preference different exchanges, namely, **post-auction discounts**, which are contractual agreements made between publishers and exchanges or ad buyers to rebate a portion of winning bids.[1051]

[1047] *See* Presentation, "Changes to Ad Manager, AdMob auction" (Sep. 3, 2019), GOOG-DOJ-14549757, at -772 ("[N]eutral publisher payment overall"); Presentation, "1PA Impact Post Launch" (Nov. 27, 2019), GOOG-DOJ-14566285, at -288 ("One month after launch, holdback experiment comparing 1PA to 2PA shows slightly lower revenues in general, but remains close to neutral across the Sell side"), -293 ("Top 3P Buyers: Positive impact due to lack of adjustment?").

[1048] Expert Report of P. Pathak (Jun. 7, 2024), at ¶ 19. *See also* Fourth Amended Complaint ¶ 453 ("Setting higher price floors for AdX and Google's buying tools permitted publishers to combat (but not solve) the problem of adverse selection caused by Google, thereby encouraging exchange and buyer participation (including those engaged in header bidding) and increasing overall yield. [...] Publishers also set high floors for Google's exchange and buying tools to diversify the sources of demand for their inventory. [...] Publishers also set higher price floors for AdX and Google's buying tools to improve the quality of the ads returned to their site and displayed to consumers.").

[1049] *See* Google, "Unified pricing rules," Google Ad Manager Help (accessed Jun. 25, 2024), https://support.google.com/admanager/answer/9298008 ("Advertiser- and brand-specific pricing can be configured in unified pricing rules.").

[1050] *See* Google, "Block sensitive categories," Google Ad Manager Help (accessed Jun. 25, 2024), https://support.google.com/admanager/answer/2541069?hl=en&sjid=14902226251943448609-EU ("You can block groups of ads that are considered 'sensitive' due to the nature of the business or ad […] Our system classifies ads automatically, and we don't rely on advertiser-provided categorization.").

[1051] *See* Seb Joseph, "WTF are post-auction discounts?," Digiday (Apr. 2 2020), https://digiday.com/media/post-auction-discounts/ ("Post-auction discounts happen when a publisher agrees to [t]ake money off of winning bids for certain impressions from an agency. So if an agency wins an impression in an auction at one price, the actual fee they pay will be lower once the discount kicks in."). Post-auction discounts were in use

525. Plaintiff and their experts claim that "[l]imiting the number of allowed reserve prices to 200 limits the publisher's ability to maximize revenues."[1052] This claim is incorrect. The limit is on "rules" and each rule allows for up to 50 distinct advertiser-specific reserve prices so the total number of allowed reserve prices is 10,000.[1053] In addition, Plaintiffs' experts do not present any evidence that this limit had any significant effect on publisher revenues.

B. Self-Competition and the Problem of Varying Floor Prices Across Exchanges

526. As explained in Section XIII, Open Bidding improved on header bidding by streamlining payments, simplifying configuration, and reducing computational burden on end users' browsers. However, advertisers still faced the risk of **self-competition**: that is, the possibility of competing against themselves for the same impression.

527. There were at least two ways in which an advertiser might end up competing against itself for the same impression.

528. *First*, by partnering with a *single* DSP that bid in multiple exchanges. Because, as acknowledged by Plaintiffs,[1054] DSPs often bid for inventory on multiple exchanges, header bidding could lead to advertisers bidding multiple times for the same impression.

by publishers using GAM from at least before 2020. *See* "Agency Programmatic Buying Models and Discounts" (Jun. 24, 2020), GOOG-DOJ-AT-00173317, at -318 ("Post-Auction Price Reduction is live with Rubicon, Index & OpenX.").

[1052] *See* Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 171.

[1053] *See* Google, "Unified First-Price Auction - Best practices," Google Ad Manager (accessed Jun. 15, 2024), https://services.google.com/fh/files/misc/unified_first-price_auction_best_practices.pdf ("You can currently specify up to 50 advertisers per pricing rule.").

[1054] Fourth Amended Complaint ¶ 71 ("Large advertisers do this with ad buying tools called demand-side platforms (commonly known as "DSPs"), which they use to optimize their spend across multiple exchanges and/or networks. Small advertisers, on the other hand, optimize and effectuate their purchases using pared-down analogues of DSPs.").

For example, if an advertiser partnered with a DSP that bid in the AdX auction and in header bidding auctions, the advertiser could find itself competing for the same impression through AdX and header bidding.[1055]

529. *Second*, by partnering with *multiple* DSPs who bid in the same exchange or auction. For instance, an advertiser might use The Trade Desk and Adobe, with each of those DSPs submitting bids on the advertiser's behalf in AdX as well as other exchanges. In situations like that, the same advertiser could end up competing against itself.

530. By itself, self-competition was not necessarily a problem for advertisers. Consider an advertiser who receives two bid requests for an impression—one each from Exchange A and Exchange B—with the same floor price of $1.50 in a unified first-price auction. The bid requests might be for either the *same* impression or *different* impressions that happen to have the same floor price, but the advertiser's bidding strategy is the same regardless: it bids as it would in a standard first-price auction (as analyzed in Section III.C.3.b) with a floor price of $1.50. For example, if the advertiser estimates that there are no other advertisers competing for the impression, then the advertiser would optimally place a bid in each exchange that *just* beats the floor price of $1.50 in either case, which is just the same as if there were no self-competition.

531. But self-competition *in combination* with varying floor prices across exchanges could harm advertisers if they (or their DSPs) fail to identify when their bid requests from

[1055] Presentation, "Optimal AdX in DFP setup: Best practices, and how to traffic RTA/RTP (header bidding) line items" (Sep. 24, 2015), GOOG-TEX-00000001, at -004 ("[H]eader bidding can make buyers bid against themselves running 2 auctions for every impression."); Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 41; [redacted]

different exchanges are competing for the same impression. The effect is similar to that of multi-calling, which was discussed in Section IV. To illustrate, consider the same example as before, but now suppose that the floor prices are \$1.50 in Exchange A and \$2.50 in Exchange B. *If* the advertiser can identify that both bid requests are for the *same* impression, then it would optimally bid \$1.50 in *both* Exchange A and Exchange B, winning the impression in the unified first-price auction (through Exchange A) at the lower price of \$1.50. *But if* the advertiser incorrectly thinks that the bid requests are for *different* impressions (when they are actually for the same impression), then it might bid \$1.50 in Exchange A and \$2.50 in Exchange B. In this case, the advertiser still wins the impression in the unified first-price auction (through Exchange B) but now pays the higher price of \$2.50: it is harmed by self-competition.

532. Avoiding self-competition before the introduction of UPR thus required DSPs to assess *many* similar or identical bid requests. One industry source reported that header bidding publishers might "send 18 identical bid requests for the same piece of inventory […] Currently, DSPs often begrudgingly evaluate them all, and find it hard to tell if the impression is exactly the same."[1056] Advertisers "struggle[d]" to de-duplicate impressions

[1056] Sarah Sluis, "The Trade Desk Suppresses Bid Duplication Amid COVID-19 Traffic Surge," AdExchanger (Apr. 21, 2020), https://www.adexchanger.com/platforms/the-trade-desk-suppresses-bid-duplication-amid-covid-19-traffic-surge/ ("Publishers that slot the same six exchanges into multiple header-bidding auctions, such as Prebid, Google open bidding and Amazon Transparent Ad Marketplace, send 18 identical bid requests for the same piece of inventory to The Trade Desk. Currently, DSPs often begrudgingly evaluate them all, and find it hard to tell if the impression is exactly the same.").

and coordinate bids made through different channels.[1057] A Vice President of The Trade Desk commented that "[m]ore problematic is that each identical impression is represented differently to buyers specifically regarding floors. If floors represent a minimum price, why does an identical impression have 26 different floors?"[1058] Google employees were concerned that the possibility of self-competition could lead to an "[e]ventual loss of advertiser trust in [real-time bidding] auctions,"[1059] and that exchange-discriminatory reserves were a way for publishers to "game[]" the system.[1060]

533. Even though varying price floors across exchanges could harm advertisers, individual publishers had an incentive to do so. By engaging in price-fishing tactics, publishers could benefit at the expense of advertisers who participated on multiple exchanges. To illustrate the possible harms of such tactics, suppose that an advertiser's value for an impression could be either $2.20 or $1.80. In a first-price auction, the advertiser's optimal

[1057] *See* Presentation, "Unified 1st Price Auction" (Mar. 4, 2019), GOOG-DOJ-06525908, at -915 ("Today, buyers struggle to optimize when bidding across different channels due to lack of symmetry: different auction rules and different floor prices can apply for the same impression."). *See also* Sarah Sluis, "Header Bidding Unleashed a Huge Infrastructure Problem and Ad Tech Will Either Sink or Swim,"AdExchanger (Apr. 24, 2017), https://www.adexchanger.com/platforms/header-bidding-unleashed-huge-infrastructure-problem-ad-tech-will-either-sink-swim/ ("Though DSPs are seeing a flood of new impressions, many of them are selling the same thing. A publisher with three header bidding partners will have three exchanges sell its inventory, tripling the amount of impressions a DSP must evaluate and tripling the listening cost. […] [M]any DSPs are devoting resources to deduplicating impressions to avoid spending millions in server fees. […] But not all DSPs have the resources to smartly filter out low-value impressions.").

[1058] Will Doherty, "The door in the floors: Transparency, price discovery, and market efficiency in programmatic," The Current (Nov. 8, 2023), https://www.thecurrent.com/will-doherty-transparency-programmatic-data ("The average premium publisher works with approximately 26 different SSPs and exchanges. Our buyers now see every impression at least 26 times, and sometimes many more. More problematic is that each identical impression is represented differently to buyers specifically regarding floors. If floors represent a minimum price, why does an identical impression have 26 different floors?").

[1059] Presentation, "Optimal AdX in DFP setup: Best practices, and how to traffic RTA/RTP (header bidding) line items" (Sep. 24, 2015), GOOG-TEX-00000001, at -004.

[1060] *See* Email from [redacted], "Re: article - trial by fire, how 6 header bidders perform" (Jan. 11, 2016), GOOG-DOJ-13364449, at -449 [redacted] pubs can still play soft floor games even with HB or Jedi. They could still put different floors on different exchanges, calling them in parallel will get a similar outcome as waterfall. [...] [redacted] Do you mean different floors? If yes we need to think the product they [*sic*] should we even allow that.").

bids depend on the floor price and on its probabilistic assessments of other bids. When the advertiser's value is *high* ($2.20), it may find it optimal to bid $1.80 if the floor price is $1 and to bid $2 if the floor price is $2. When its value is *low* ($1.80), it might be optimal to bid $1.50 if the floor price is $1 and not bid at all in an auction with a floor price of $2. If the advertiser multi-homes and bids in two exchanges (Exchange A and Exchange B), then a publisher that solicits bids from those two exchanges for a single impression could exploit the advertiser's bidding behavior by setting a floor price of $2 on Exchange A and a lower floor price on Exchange B. If the advertiser is unable to detect that its bid requests from Exchange A and Exchange B are actually for the same impression, then:

a. When its value is high, it might win the impression on Exchange A with a bid of $2 even when its lower bid of $1.80 on Exchange B would otherwise have won the impression.

b. When its value is low, the advertiser wins the impression on Exchange B.

The effect is similar to that of multi-calling as discussed in Section V: the publisher extracts more revenue from the advertiser than it could with any fixed floor price.

534. Gaming floor prices in this way damages the safety and simplicity of Google's platform because the advertiser cannot rely on the floor price reported at an exchange being the publisher's lowest acceptable price for the impression. Although the example above might suggest that price-fishing is a mere transfer of surplus from the advertiser to the publisher, the problem is worse: total surplus can be reduced due to the changes in advertiser behavior that price-fishing incentivizes. If the advertiser is aware of the

publisher's tactics, its best response is to bid less in an auction with a higher floor price, understanding that the same impression may be available via a different exchange at a lower price. However, such optimization is difficult, particularly because it is in the publisher's interest to hide from the advertisers that they are being called multiple times. One consequence would be the need for advertisers to invest in technology to track impressions and floor prices across exchanges to protect against the possibility of self-competition. If that proved too difficult or costly, advertisers might reduce multi-homing, bid less on *all* impressions, or reduce the number of impressions they bid on.[1061] Thus, by preventing price-fishing (and removing an incentive for advertisers to reduce their bids), UPR also benefited the majority of publishers that did not engage in such tactics.

C. Unified Pricing Rules Protected Advertisers and Benefited Publishers in the UFPA

535. Along with its launch of the Unified First Price Auction in 2019, Google introduced Unified Pricing Rules (UPR).[1062] Before the introduction of UPR, publishers could set floor prices in AdX for specific bidders, including Google Ads, DV360, non-Google DSPs, and ad networks. These floor prices were implemented via "pricing rules," with publishers able to configure up to 5,000 floor prices in this way.[1063] On the other hand,

[1061] *See* Deposition of [redacted] at 236:15-18 [redacted] GOOG-AT-MDL-007177040, at -276 ("You know, if there were [multiple] floors being set to artificially raise prices from an auction standpoint, that could scare buyers away.").

[1062] *See* Jason Bigler, "An update on first price auctions for Google Ad Manager," Google Ad Manager Blog (May 10, 2019), https://blog.google/products/admanager/update-first-price-auctions-google-ad-manager/ ("In addition to impacting how publishers are using floor price rules, changing to a first price auction in Ad Manager requires a change in how our rules function. […] That's why we released a new feature to all publishers globally, called unified pricing rules.").

[1063] *See* Lucie Laurendon, "Google Unified First Price Auction Explained," Smart Ad Server Blog (captured on Mar. 7, 2022) at

publishers could *not* use GAM to set floor prices for Open Bidding exchanges and other indirect sources of demand: instead, they needed to configure floor prices for each exchange separately using that exchange's user interface.[1064] The consequence of this piecemeal system was that "[p]ubs set different floors for the same buyer on different exchanges,"[1065] and, as a result, multi-homing advertisers—those who bid across multiple different channels—could face different floor prices for the same impression on different exchanges. As described above, these advertisers "struggle[d]" to de-duplicate impressions and coordinate bids made through different channels and, as a result, could be exposed to price-fishing tactics.[1066]

536. Under UPR, the same floor prices publishers set in GAM apply equally to AdX, other participating exchanges, and remnant line items (including any header bidding demand). This protected advertisers from publishers' price-fishing tactics. UPR did not prevent

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http://web.archive.org/web/20220307203150/https://smartadserver.com/articles/google-unified-first-price-auction-explained/ ("Publishers will only be able to set UPR with a limit of 200 (vs 5,000 OA rules before).").

[1064] *See* Comms Doc, "Ad Manager Unified 1st Price Auction" (Sep. 27, 2019), GOOG-DOJ-09714662, at -664 ("[Publishers] are unable to [set pricing floors in the Ad Manager UI] for Exchange Bidding and other indirect sources of demand trafficked through non-guaranteed line items."); Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 40 ("However, publishers were unable to use the Google Ad Manager user interface to set pricing floors for Open Bidding partners and other indirect sources of demand trafficked through non-guaranteed line items. Instead, publishers had to undertake the complex and time-consuming task of configuring pricing floors separately on each exchange and network where their inventory was available.").

[1065] Presentation, "DRX Unified Yield Management Strategy Review" (Jul. 9, 2018), GOOG-DOJ-11781854, at -869 ("Pubs set different floors for the same buyer on different exchanges to simulate a real-time waterfall and soft floor the buyers (like DBM), and AdX primarily bears the brunt of these higher floors").

[1066] *See* Presentation, "Unified 1st Price Auction" (Mar. 4, 2019), GOOG-DOJ-06525908, at -915 ("Today, buyers struggle to optimize when bidding across different channels due to lack of symmetry: different auction rules and different floor prices can apply for the same impression."). *See also* Sarah Sluis, "Header Bidding Unleashed a Huge Infrastructure Problem and Ad Tech Will Either Sink or Swim," AdExchanger (Apr. 24, 2017), https://www.adexchanger.com/platforms/header-bidding-unleashed-huge-infrastructure-problem-ad-tech-will-either-sink-swim/ ("Though DSPs are seeing a flood of new impressions, many of them are selling the same thing. A publisher with three header bidding partners will have three exchanges sell its inventory, tripling the amount of impressions a DSP must evaluate and tripling the listening cost. […] [M]any DSPs are devoting resources to deduplicating impressions to avoid spending millions in server fees. […] But not all DSPs have the resources to smartly filter out low-value impressions.").

publishers from configuring floor prices based on the advertiser, the ad size, and the inventory type (*e.g.*, display, mobile, and app), with a limit of 200 floor pricing rules at any time.[1067]

537. By protecting advertisers from price-fishing, UPR also benefited publishers. Although individual publishers might be incentivized to engage in price-fishing tactics, advertisers might end up bidding less on *all* impressions, which in turn could end up harming *all* publishers. This is a well-known economic phenomenon akin to the *tragedy of the commons*[1068]: price-fishing publishers impose an *externality* that harms advertisers and other publishers. By preventing publishers from engaging in that type of gamesmanship, UPR protected advertisers and publishers that were not price-fishing.

538. A third-party survey of publishers in February 2020, after the introduction of UFPA with UPR, found that only 4% of respondents described UPR as having a negative impact on their business.[1069] Post-launch experiments found that the changes had [redacted] for non-Google DSPs buying via AdX and [redacted] total publisher revenues [redacted].[1070]

[1067] *See* Google, "Unified pricing rules," Google Ad Manager Help (accessed Jun. 25, 2024), https://support.google.com/admanager/answer/9298008 ("You can apply up to 200 unified pricing rules per Ad Manager network.").

[1068] *See, e.g.*, Ostrom, E. (2008). Tragedy of the commons. In S. N. Durlauf & L. E. Blume (Eds.), *The New Palgrave Dictionary of Economics*, 2nd ed. (pp. 360-363). Palgrave Macmillan.

[1069] *See* Advertiser Perceptions, "SSP Report: Part of the Programmatic Intelligence Report" (Apr. 16, 2020), GOOG-DOJ-AT-00608572, at -573 ("Sample: Digital sales and operations contacts from The Advertiser Perceptions Ad Pros proprietary community and trusted third-party partners as needed [...] Fielded 2/3 to 2/14 2020"), -577 (Figure [dark blue bars correspond to "Negative Impact"]). *See also* Sarah Sluis, "Google Ad Manager Policy Changes Don't Hurt Publishers, According to Advertiser Perceptions," AdExchanger (May 5, 2020), https://www.adexchanger.com/platforms/google-ad-manager-policy-changes-dont-hurt-publishers-according-to-advertiser-perceptions/ ("Google's recently changed rules around unified pricing only negatively impacted 4% of publishers.").

[1070] *See* Presentation, "Changes to Ad Manager, AdMob auction" (Sep. 3, 2019), GOOG-DOJ-14549757, at -772 [redacted] Presentation, "1PA Impact Post Launch" (Nov. 27, 2019), GOOG-DOJ-14566285, at -288 [redacted]

D. Under UPR, Publishers Could Still Preference Demand Sources

539. Even though UPR prevented publishers from setting exchange-discriminatory reserves, publishers still had other tools to favor their preferred demand sources.

540. *First*, a publisher could favor a header bidding exchange by modifying the value CPMs on the line items used to represent that exchange's header bid.[1071] Inflating the value CPMs in that way would make the header bidding exchange more likely to be allocated the impression in the UFPA and would not increase the price for the impression paid by the header bidding exchange (because, as discussed in Paragraph 115 above, the value CPMs reported by publishers do not affect the prices paid by remnant line items). Publishers could also choose to offer some impressions only to their preferred exchanges via header bidding.[1072]

541. *Second*, publishers could also favor certain exchanges or advertisers by offering them post-auction discounts. Post-auction discounts are contractual agreements between publishers and ad buyers and exchanges, in which the publisher agrees to rebate a fraction of the winning bids made by the ad buyer or exchange after the auction has concluded. An ad buyer with such an agreement is incentivized to bid more in each auction for an impression, making it more likely that it wins the impression. As a result, post-auction discounts can be used to increase the share of impressions that are allocated

[redacted]"), -293 [redacted]").

[1071] *See, e.g.*, Asmaâ Bentahar, "Bid Adjustments Simplified: Run Fair Auctions with no Hassle," Pubstack (May 2, 2021), https://www.pubstack.io/topics/bid-adjustments-simplified ("Alternatively, this next one will slightly increase all returned CPMs, giving Prebid an edge in the competition against GAM").

[1072] *See, e.g.*, Prebid.org, "Running Prebid.js without an ad server" (accessed Sep. 7, 2023), https://docs.prebid.org/dev-docs/examples/no-adserver.html ("This example demonstrates running [a header bidding] auction and rendering without an ad server.").

to a given ad buyer or exchange. For example, suppose the publisher agrees to rebate 50% of the winning bids from a certain DSP. If there is a uniform floor price of $3 for an impression and (absent the discount) the DSP would have only been willing to pay $2 for the impression, then *with* the discount, the DSP would be willing to bid $4, which exceeds the floor price. If its bid is the highest bid for the impression, the advertiser bidding using that DSP would be allocated the impression, paying only half its bid to the publisher. As a result, the post-auction discount has a similar effect as a lower floor price for the bidder, but without leading to other harms (such as price-fishing).

542. Post-auction discounts are routinely used in the market for display advertising. An internal Google document from June 2020 notes its use [redacted][1073] As Michael McNeeley, VP of Product at Index Exchange, described in an interview with Digiday, "[p]ost-auction discounts give publishers' sales team the chance to go and incentivize spend with advertisers just like they do for other forms of media," and, as commented by the article's author, "[t]his is actually not a new trend, as bid prioritization and bid modifiers for certain agencies have been used by publishers in SSP platforms for many years."[1074]

543. In an auction, post-auction discounts are usually a better tool for publishers than differential floor prices. In theory, when bidders are asymmetric in their willingness to pay or in their quality, then an optimal handicapping process causes different bidders to

[1073] "Agency Programmatic Buying Models and Discounts," (Jun. 24, 2020), GOOG-DOJ-AT-00173317, at -318 ("Post-Auction Price Reduction is live with [redacted].").

[1074] Seb Joseph, "Ad-buying agencies are cozying up to SSPs, creating more transparency questions," Digiday (Mar. 31, 2020), https://digiday.com/marketing/ad-buying-agencies-are-cozying-up-to-ssps-creating-more-transparency-questions/.

be charged different prices when they win.[1075] Appropriately designed post-auction discounts can often approximate the optimal process, while exchange-discriminatory floor prices, which use the same prices for any winning bidder whose bid exceeds its floor, cannot generally approximate the optimal mechanism.[1076] As a result, exchange-discriminatory floor prices are a less effective tool.

E. Responding to Plaintiffs' Allegations

1. Plaintiffs Neglect the Industry-Wide Acceptance of UPR and Its Benefits to Advertisers and Publishers

544. Plaintiffs fail to recognize the benefits of UPR to multi-homing advertisers and non-multi-calling publishers in the UFPA. As I have described above, UPR made it easier for publishers to set floor prices for non-Google exchanges in Open Bidding. Maintaining the ability to set exchange-discriminatory floor prices would likely have both made it more difficult for advertisers to bid optimally on Google's platform and led to externalities from price-fishing that would harm other publishers.

545. While providing no concrete evidence, Plaintiffs suggest that publishers would have benefited from setting higher reserve prices "for Google exchange and buying tools."[1077] Yet, they neglect the fact that unified pricing rules are now an industry-wide "best-practice."[1078] For example, Xandr now recommends—as part of its "Seller Best

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[1075] *See* Milgrom, P. R. (2004). *Putting auction theory to work*. Cambridge University Press, at 24-25, 149-53.

[1076] In the technical notes in Section XV.G, I show using an example that the publisher can obtain strictly higher revenues with post-auction discounts than with differential price floors.

[1077] Fourth Amended Complaint ¶ 453.

[1078] *See* Xandr, "Seller Best Practices" (May 5, 2023), https://docs.xandr.com/bundle/industry-reference/page/seller-best-practices.html.

Practices" listed on its "Industry Reference" Documentation Center—to "[e]stablish consistent price floors for the same inventory in all systems (*i.e.*, ad server unified pricing rules, line item CPMs, deal prices, SSP floors, etc.)."[1079]

546. Other online display advertising intermediaries have similar rules requiring floor prices to be uniform across bidders. For example, Meta enforces a "code of conduct" for the auctions it participates in, requiring that all bidders in each auction face the same floor prices,[1080] and [redacted].[1081] As a VP at The Trade Desk expressed, "[i]n a perfect world [...] floor[s] would be consistent and constant" and "would be the same regardless of path."[1082]

547. Professor Gans concludes that, "if Google had not had market power in the publisher ad server market and had not been vertically integrated from that market into an adjacent vertical segment (the exchange market), it would have neither had the ability nor the incentive to engage in the conduct described,"[1083] but the use and preference for such

[1079] Xandr, "Seller Best Practices" (May 5, 2023), https://docs.xandr.com/bundle/industry-reference/page/seller-best-practices.html.

[1080] Meta, "Code of Conduct," Meta Audience Network" (accessed Dec. 2, 2023), https://www.facebook.com/audiencenetwork/partner-program/code-of-conduct ("When a reserve price is applied as part of the auction, it should apply identically to all demand sources."). *See also* [redacted]

[1081] *See* [redacted]

[1082] Will Doherty, "The door in the floors: Transparency, price discovery, and market efficiency in programmatic," The Current (Nov. 8, 2023), https://www.thecurrent.com/will-doherty-transparency-programmatic-data.

[1083] Expert Report of J. Gans (Jun. 7, 2024), at ¶ 458.

rules, including by smaller firms and ones representing just one side of the market, contradicts this conclusion.[1084]

2. Plaintiffs Neglect How UFPA Changed Publishers' Incentives to Set Differential Floor Prices

548. Plaintiffs and their experts argue that "[h]istorically, publishers set different price floors for different exchanges and different buyers in the publisher ad server," and often spent "considerable resources" to do so.[1085] Professor Pathak claims that these higher floor prices were used "to account for the perceived lower ad-quality of impressions served through AdX"—a claim for which he offers no evidence.[1086] And Plaintiffs fail to account for the more obvious reasons that optimal floor prices were higher for AdX before the transition to the UFPA. With earlier ad allocation processes, bids from different exchanges were evaluated sequentially (as in waterfall and Dynamic Allocation) and, often, AdX was running a second-price auction alongside Header Bidding's first-price auctions (as in Open Bidding). In such cases, it was optimal for publishers to set different floor prices for different exchanges, as I explain below. However, those reasons for different floor prices were eliminated by the introduction of the Unified First Price Auction (UFPA).

549. Let us see how setting exchange-discriminatory floor prices could help publishers maximize revenues in a system where the winning bids from multiple exchanges were

[1084] *See* [redacted]

[1085] Fourth Amended Complaint ¶ 452.

[1086] Expert Report of P. Pathak (Jun. 7, 2024), at ¶ 157.

evaluated sequentially. For example, consider a publisher that sequentially calls two exchanges in the waterfall: Exchange A before Exchange B. Suppose that the publisher believes that the distributions of advertiser values at both exchanges are identical and that the values of bidders at each exchange are statistically independent.[1087] Then the publisher's revenue-maximizing floor price for Exchange A is *higher* than that for Exchange B.[1088] This is because, by choosing a higher floor price for Exchange A, the publisher can try to extract a higher price from the first exchange, knowing that it can offer the impression to Exchange B if it fails to sell on Exchange A.[1089] Similarly, exchange-specific (and impression-specific) floor prices could improve publisher revenues when header bidding exchanges and AdX were not called simultaneously and used different auction rules, as I discussed in Section X.

550. These potential benefits of setting floor prices that differ by exchange are eliminated in the UFPA because bids from all exchanges are evaluated *simultaneously* and *uniformly*. In the above example, the publisher maximizes its revenue in the UFPA by setting the same floor price for both exchanges. This is because the optimal floor price for an exchange trades off the *expected benefits* of increasing the auction's clearing price (when that exchange provides the largest bid and that bid is the only one above the floor price) against the *expected costs* of failing to sell the impression (when that exchange provides

[1087] That is, knowing the value of a bidder at Exchange A does not change the publisher's beliefs about the values of bidders at Exchange B, and vice versa. This is the "independent private values" class of auction models.

[1088] To illustrate, suppose that each exchange has two bidders whose values are drawn independently and uniformly between $0.00 and $1.00. Then the optimal floor price for Exchange A is $0.71 while that for Exchange A is $0.50. In a Unified First Price Auction, the optimal floor price for both exchanges is $0.50.

[1089] *See, e.g.*, Despotakis, S., Ravi, R., & Sayedi, A. (2021). First-price auctions in online display advertising. *Journal of Marketing Research*, *58*(5), 888-907, at "Example 1," 895.

the largest bid and that bid is below the chosen floor price). This tradeoff is the same for the two identical exchanges, and so the optimal floor price is the same as well.[1090]

551. Plaintiffs and their experts fail to account for the fact that publishers would optimally set a higher floor price for AdX prior to the introduction of UFPA even if AdX advertisers had the same quality and distribution of values as other advertisers. In that case, once the transition to UFPA had been completed and advertisers and publishers adapted to the new rules, the earlier reasons to set a higher reserve for AdX would be eliminated and equal reserve prices would be optimal. Even if differences in perceived quality among demand sources are important to some publishers—as claimed by Professor Pathak[1091]—Plaintiffs and their experts do not explain why the filtering tools and the pricing of sensitive categories available within UPR are not sufficient to manage such concerns.

552. In asserting that if "AdX faced the highest reserve pre-UPR, [then] UPR would naturally benefit Google's ad exchange AdX both in win rate and in revenue,"[1092] Professor Weinberg fails to account for the reason that AdX would have faced a higher optimal floor price prior to the transition to the UFPA—the sequential nature of the previous auction format. Even if a publisher rationally set higher floor prices for AdX *before* the UFPA, one cannot assume (as Professor Weinberg does) that it would be optimal for AdX to face a higher floor price *after* the transition to the UFPA.

[1090] This finding continues to be true if the number of bidders differ by exchange, since the optimal floor price in the independent private values setting does not depend on the number of bidders (only on the distribution of values associated with those bidders). *See* Riley, J. G., & Samuelson, W. F. (1981). Optimal auctions. *American Economic Review*, *71*(3), 381-392.

[1091] Expert Report of P. Pathak (Jun. 7, 2024), at ¶ 157.

[1092] Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 182.

3. Plaintiffs Ignore Alternative Ways Publishers Could Favor Non-Google Demand Sources and Manage Ad Quality After UPR Was Introduced

553. Plaintiffs and their experts claim that UPR prevented publishers from using exchange-discriminatory floor prices for various legitimate business reasons, including "to diversify the sources of demand for their inventory," "to combat [] the problem of adverse selection," and "to improve the quality of ads returned to their site."[1093] Yet, Plaintiffs and their experts fail to mention that publishers had access to more effective tools to achieve these same objectives if the need arose.

554. For example, a publisher wishing to preference a non-Google exchange "to diversify the sources of demand for their inventory" or to "combat problems of adverse selection" could do so by providing a post-auction discount (as discussed in Section XIV.D) or (for header bidding exchanges) by modifying the value CPMs on the line items used to represent that exchange's header bid. Either of these adjustments would lead the favored demand source to win a larger share of the impressions.

555. A publisher wishing to address ad quality concerns also has more direct tools than exchange-discriminatory floor prices. Professor Pathak offers as an "example, a website that publishes stories for children would want to refrain from showing ads related to tobacco or alcohol products."[1094] Firstly, GAM prohibits non-age appropriate ads from being shown to teens and children, and ads for alcohol and tobacco products are even

[1093] Fourth Amended Complaint ¶ 453. *See also* Expert Report of P. Pathak (Jun. 7, 2024), at ¶¶ 157 ("Historically, publishers set higher reserve price floors for AdX to account for the perceived lower ad-quality of impressions served through AdX and increase diversity of demand sources."), 159 ("By eliminating publishers' ability to set differential price floors across exchanges, Google removed a key tool used by publishers to maximize the yield on their inventory and ensure acceptable quality advertisements were displayed on their web pages.").

[1094] Expert Report of P. Pathak (Jun. 7, 2024), at ¶ 171.

more broadly restricted.[1095] In addition, advertisers "can mark [their] ad requests to be treated as child-directed. The feature is designed to help facilitate compliance with the Children's Online Privacy Protection Act (COPPA)."[1096] More broadly, GAM makes ad content protection features available to all publishers, allowing them to avoid presenting ads with sensitive content, ads from specific buyers, or ads in general categories such as "Apparel, Finance, and Health."[1097] Finally, GAM also allows publishers to set category specific floor prices for the sensitive categories.[1098]

556. Publishers could also set advertiser-specific floor prices to address ad quality concerns from specific advertisers. Advertiser-specific floor prices would be more effective than exchange-discriminatory floor prices due to the prevalence of advertiser multi-homing.[1099] When a publisher raises the floor price of a DSP, any low-quality advertisers using that DSP would have an incentive to move their campaigns to another

[1095] *See* Google, "Ad-serving Protections for Teens," Google Ad Manager and Ad Exchange Program Policies (accessed Jun. 26, 2024), https://support.google.com/admanager/answer/12171027?hl=en&sjid=2354124647482356745-EU.

[1096] *See* Google, "Tag an ad request for child-directed treatment (TFCD)," Google Ad Manager and Ad Exchange Program Policies (accessed Jun. 24, 2024), https://support.google.com/admanager/answer/3671211?hl=en&ref_topic=28145.

[1097] *See* Google, "Block general categories," Google Ad Manager Help (accessed Jul. 17, 2024), https://support.google.com/admanager/answer/2913554?sjid=2617898862681288879-EU ("You can block high-level groupings of ads — such as Apparel, Finance, and Health — from appearing on your network or specified inventory.").

[1098] *See* Google, "Unified pricing rules," Google Ad Manager Help (accessed Jun. 25, 2024), https://support.google.com/admanager/answer/9298008 ("You can set pricing rules that apply only to creatives in selected sensitive categories. Some ads are considered 'sensitive' due to the nature of the business or ad—such as Sensationalism or Significant Skin Exposure. Our system classifies ads automatically, and we don't rely on advertiser-provided categorization.").

[1099] In a 2021 survey, respondent advertisers and ad agencies (who all spent a minimum of $1M annually on digital ads) used an average of 3.4 DSPs and planned to use 5.9 DSPs the following year. *See* Advertiser Perceptions, "DSP Report: Demand-Side Platforms" (2021), GOOG-DOJ-AT-02524665, at -666, -670. *See also, e.g.*, [redacted]

DSP. Only by setting high floor prices for that advertiser *across all exchanges* could a publisher effectively block ads from that advertiser. As discussed in Section XIV.D, publishers could also use post-auction discounts to favor specific exchanges or advertisers with higher-quality ads.

557. Plaintiffs allege that "Google's Unified Pricing rules ensure that rival exchanges and buying tools are at a price disadvantage[] [b]ecause Google's publisher ad server imposes extra fees to serve ad inventory sold on non-Google exchanges [...]."[1100] This is incorrect: no additional fees are charged on ad inventory sold to header bidding exchanges. For exchanges participating in Open Bidding, Google's Open Bidding revenue share pays for valuable services, which for publishers include reporting, payment processing, and integration with non-Google exchanges, and for exchanges include real-time processing of the huge number of bids they submit on each impression. Plaintiffs fail to account for these valuable services when assessing any "disadvantage" to non-Google exchanges. Moreover, a publisher seeking to avoid the Open Bidding revenue share could use header bidding to process real-time bids from relevant exchanges. Or, if a publisher wished to account for fee differences in Open Bidding, it could offer a post-auction discount to Open Bidding exchanges to offset the fee differential.

558. Plaintiffs and their experts also claim that setting exchange-specific price floors could increase the publisher's revenue when the distribution of bidder values differs across the exchanges. Professor Weinberg illustrates his claim with the following example: "imagine that there is a single AdX bidder whose value is distributed uniformly on [12,16], and there is a single OpenX bidder whose value is distributed uniformly on

[1100] Fourth Amended Complaint ¶ 461.

[10,12]. In this case, the revenue-optimal personalized reserves are $13 on AdX and $10 on OpenX."[1101] I show in the technical notes in Section XV.F that the publisher can do *even better* using a uniform reserve price of $12 and a $2 post-auction discount for OpenX. The proper lesson from Professor Weinberg's example is that differences in values can be better managed by post-auction discounts, such as I have described in my published work, rather than by non-uniform reserves.[1102]

559. Finally, Professor Gans claims that "[t]he ability to set flexible pricing floors is valuable to publishers, as it enables them to extract value from high-quality impressions [...]."[1103] He elaborates, "Google buying tools have more information about users than third-party buying tools. As Google's buying tools were more likely to identify high-demand impressions, setting higher pricing floors for Google's buying tools allowed publishers to extract a larger share of the value of those high-demand impressions."[1104] But Professor Gans does not provide any evidence that Google Ads and DV360 actually have "more information" than other buying tools and, even if they do in some circumstances, Professor Gans fails to show the prevalence of such situations and fails to analyze alternative instruments like post-auction discounts that can serve a similar purpose as differential pricing floors.

[1101] Expert Report of M. Weinberg (Jun. 7, 2024), at ft. 248.

[1102] *See* Milgrom, P. R. (2004). *Putting auction theory to work*. Cambridge University Press, at 234-37 (discussing bidding credits as a way to increase revenues with asymmetric bidders).

[1103] Expert Report of J. Gans (Jun. 7, 2024), at ¶ 509.

[1104] Expert Report of J. Gans (Jun. 7, 2024), at ¶ 512.

4. Plaintiffs Fail to Recognize that Each UPR Allows for Up To 50 Advertiser-Specific Floor Prices

560. Plaintiffs' experts claim that advertisers were harmed by the low number of pricing rules, but provide no evidence that was the case. Professor Gans states, "Analyzing Google-produced data on AdX transactions, I find that the average publisher using AdX transacts on average with [redacted] advertisers per month. Large publishers (transacting at least 1 million impressions per month) deal on average with over [redacted] advertisers per month. These numbers greatly contrast with the 200 pricing rules limit imposed by UPR."[1105] This is wrong in several ways. First, as a practical matter, advertisers can be usefully categorized into groups, making it unnecessary to set a separate rule for each advertiser. Second, "pricing rules" are different from "price floors": publishers can "specify up to 50 advertisers per pricing rule," which in principle allows specific floor prices for up to 10,000 advertisers.[1106] Third, Google has policies in place to grant extensions beyond the 200 rules.[1107]

561. Google also demonstrated responsiveness to advertiser concerns about the limits. Based on publisher feedback that 100 rules would be too limiting, Google "increas[ed] the maximum number of pricing rules" to 200 when the UFPA with UPR was fully

[1105] Expert Report of J. Gans (Jun. 7, 2024), at ¶ 510.

[1106] Google, "Unified First-Price Auction - Best practices," Google Ad Manager (accessed Jun. 15, 2024), https://services.google.com/fh/files/misc/unified_first-price_auction_best_practices.pdf; *see* Google, "System maximums and limits," Google Ad Manager Help Center (accessed Jun. 26, 2024), https://support.google.com/admanager/answer/1628457?hl=en.

[1107] *See* Email from [redacted], "Re: UPR 500 rule exceptions" (Nov. 19, 2019), GOOG-DOJ-14028590, at -590 ("Extension requests for < 300 rules -> Lightweight approval [...] Requests for extensions with no rules specified will be capped at 300 [...] Extension requests for > 300 rules -> Needs PM to review business rationale and approve [...] We have generally been granting exceptions whenever a clear reason to justify granular targeting was presented[.]").

launched.[1108] I have not seen any evidence of widespread demand for Google to increase the 200-rule limit further.

[1108] Jason Bigler, "Rolling out first price auctions to Google Ad Manager partners," Google Ad Manager (Sep. 5, 2019), https://blog.google/products/admanager/rolling-out-first-price-auctions-google-ad-manager-partners/.

XV: TECHNICAL NOTES

A. Technical Notes for Section IV (Google Ads Bidding Programs)

1. Theorem 1: Statement and Proof

562. **Theorem 1:** Suppose that Google changes from direct bidding to a bid optimization program, causing its bids to increase and the publisher to revise its floor price.[1109] Further, suppose that the combined effect is that Google Ads' win rate for a given advertiser increases. In addition:

a. Let v denote the advertiser's value for impressions, assumed to be a random variable with finite mean drawn from a twice continuously differentiable distribution F with a strictly positive probability density function f supported on a closed subset of $[\underset{\sim}{v}, \infty)$.

b. Let λ denote the inverse hazard rate function for the distribution F, defined by $\lambda(v) = \frac{1-F(v)}{f(v)}$.

c. Let M denote the change in the Google Ads win rate.

d. Let S denote the change in the advertiser's *ex ante* expected surplus.

e. Let r denote the publisher's floor price for Google Ads under direct bidding.

If $\lambda(v)$ is non-decreasing for all $[r, \widetilde{v}]$ and $M > 1 - F(\widetilde{v})$, then $S > 0$.

[1109] For this theorem, I assume that other advertisers' bids are unchanged. The profit-maximizing bids for DSPs submitting one bid in the AdX second-price auction would be unaffected by any changes in Google Ads' bids.

563. ***Proof.*** I use the Revelation Principle, conducting my analysis in the space of so-called "direct revelation mechanisms," which map from the advertiser's reported value to interim allocations and payments.[1110] Let $x\colon [\underline{v}, \infty] \rightarrow [0,1]$ be the interim allocation function of the advertiser under direct bidding (*i.e.*, $x(v)$ is the probability that an advertiser with value v wins the auction), and let $x'\colon [\underline{v}, \infty] \rightarrow [0,1]$ be the interim allocation function of the advertiser under the bid optimization program and applying the revised publisher floor price. The increase in the Google Ads win rate after the two changes is then

$$M = \int_{\underline{v}}^{\infty} [x'(v) - x(v)]\, dF(v),$$

which is assumed to be positive for this theorem.

564. By the Milgrom-Segal Envelope Theorem,[1111] for any interim allocation function $y(v) \in [0,1]$ and interim payment function $t(v)$, the surplus of an advertiser with value v is

$$U(v) = \max_{s \in [\underline{v}, \infty]} \{vy(s) - t(s)\} = \int_{\underline{v}}^{v} y(s)ds.$$

To derive this expression, I used the fact that the bidder with the lowest possible value always loses and pays zero, so $t(\underline{v}) = 0$. Note that

$\int_{\underline{v}}^{\infty} U(v)dF(v) \leq \int_{\underline{v}}^{\infty} (v - \underline{v})dF(v) < \infty$ because the mean of valuation exists. Then the *ex ante* expected surplus of such an advertiser is

[1110] *See*, *e.g.*, Myerson, R. B. (1981). Optimal auction design. *Mathematics of Operations Research*, *6*(1), 58-73.

[1111] Milgrom, P., and Segal, I. (2002). Envelope theorems for arbitrary choice sets. *Econometrica*, *70*(2), 583-601.

$$\int_{v}^{\infty} U(v)dF(v) = \int_{v}^{\infty}\int_{v}^{v} y(s)ds\, dF(v) = \int_{v}^{\infty}\int_{v}^{\infty} 1\{v' < v\}y(v')dv'dF(v) = \int_{v}^{\infty} y(v)(1 - F(v))dv.$$

This implies that the change in *ex ante* expected advertiser surplus caused by the bid optimization program is

$$S = \int_{v}^{\infty}[x'(v) - x(v)](1 - F(v))dv = \int_{v}^{\infty}[x'(v) - x(v)]\lambda(v)\, dF(v)\,.$$

565. Let r' denote the advertiser's *value threshold*, that is, the value that, under the bid optimization program, leads to a bid equal to the publisher's chosen floor price.[1112] There are two cases: either $r' < r$ or $r' \geq r$. That is, the value threshold may be lower or higher than before the changes.

566. In the first case ($r' < r$), since the bid optimization program increases bids, $x'(v) \geq x(v)$ for all v, with strict inequality for some open set of values. Hence the advertiser's *ex ante* expected surplus increases as well:

$$S = \int_{v}^{\infty}[x'(v) - x(v)](1 - F(v))\, dv > 0.$$

567. In the second case ($r' \geq r$), the interim allocation functions x and x' satisfy

a. $x'(v) \geq x(v) \geq 0$ for $v \geq r'$, since the bid optimization program increases the bid for an advertiser with value v, and for bids above the relevant floor price, that increases the probability its bid beats those of other bidders.

b. $x'(v) = 0 \leq x(v)$ for $r \leq v < r'$, since all advertisers with values above r had a chance of winning the impression under direct bidding, but only advertisers with

[1112] To make this concrete: under Bernanke with a high bid multiplier βv and post-Bernanke reserve R, the resulting value threshold is $r'=R/\beta$.

values above r' can win the impression after the optimization program is introduced.

c. $x'(v) = 0 = x(v)$ for $v < r \leq r'$, that is, no advertisers with value less than r wins with or without the optimization program.

568. Define the function Δ: $[\underline{v}, \tilde{v}] \to R$ by

$$\Delta(v) = \int_{v}^{\tilde{v}} [x'(s) - x(s)] dF(s).$$

The previous paragraph implies that $\frac{d\Delta}{dv}(v) =- [x'(v) - x(v)]f(v)$ is nonnegative for $v < r'$ and nonpositive for $v > r'$, so $\Delta(v)$ is quasiconcave in v (that is, the function is nondecreasing and then nonincreasing on its domain).

569. The condition $M \geq 1 - F(\tilde{v})$ guarantees that:

$$\Delta(v) = \int_{v}^{\tilde{v}} [x'(v) - x(v)]\, dF(v) = M - \int_{\tilde{v}}^{\infty} [x'(v) - x(v)]\, dF(v) \geq M - [1 - F(\tilde{v})] > 0,$$

where the first inequality follows because $[x'(v) - x(v)] \leq 1$. Moreover, because $[x'(v) - x(v)] \leq 0$ for $v < r'$.

$$1 - F(\tilde{v}) < M \leq \int_{r'}^{\infty} [x'(v) - x(v)]\, dF(v) \leq 1 - F(r').$$

Thus, $\tilde{v} > r'$ which implies that $[x'(v) - x(v)] \geq 0$ for all $v \geq \tilde{v}$ with strict inequality for an open set of values. Therefore,

$$S > \int_{v}^{\tilde{v}} [x'(v) - x(v)]\lambda(v)\, dF(v).$$

570. The final step of the proof is to show that $\int_{\underline{v}}^{\tilde{v}} [x'(v) - x(v)]\lambda(v)\, dF(v) \geq 0$. To do so, I use the Barlow-Proschan Lemma[1113], stated below

> **Barlow-Proschan Lemma:** Suppose that W is a signed measure on the interval (a, b) with $\int_{v}^{b} dW(s) \geq 0$ for all $s \in (a, b)$ and that g is a nondecreasing, nonnegative function defined on the same interval. Then $\int_{a}^{b} g(s) dW(s) \geq 0$.

I use this lemma with $dW(s) = (x'(s) - x(s))dF(s)$ and $g(s) = \lambda(s)$ for $s \in (\underline{v}, \tilde{v})$. The condition $\int_{v}^{\tilde{v}} [x'(s) - x(s)]dF(s) \geq 0$ for $v \in (\underline{v}, \tilde{v})$ holds because, as shown above, $\Delta(\underline{v}) \geq 0$, $\Delta(\tilde{v}) = 0$ and $\Delta(v)$ is quasiconcave. The condition that g is a nondecreasing, nonnegative function holds by the assumption of the Theorem.

571. **Corollary 1:** Suppose that the assumptions of Theorem 1 continue to hold, and the distribution of v satisfies DHR for values above r.[1114] Then Google Ads' advertiser surplus also increases: $S > 0$.

[1113] Barlow, R. E., & Proschan, F. (1975). *Statistical theory of reliability and life testing: probability models* (Vol. 1). New York: Holt, Rinehart and Winston.

[1114] That is, that is, the so-called "hazard rate" function $v \mapsto f(v) / [1-F(v)]$ is decreasing in v. Equivalently, DHR is equivalent to the property that the logarithm of the survival function (the so-called "log-survival" function) of distribution F, which is the function $v \mapsto \log[1-F(v)]$, is convex (*i.e.*, the line drawn between any two distinct points on that function's graph lies above the function's graph).

2. Verifying the DHR Condition of Corollary 1 and Calculating Minimum Advertiser Surplus Using Google Ads Data

572. I now use the **Google Ads Log-Level Dataset**[1115] to assess how closely the distributions of advertiser values in Google Ads fit distributions in the family covered in Corollary 1. If the DHR condition holds exactly, Theorem 1 implies that Google Ads' bid optimization programs increased advertiser surplus if the program also increased Google's Ads' win rate. If the DHR condition holds approximately, I calculate a minimal increase in Google Ads' win rate that also guarantees that Google Ads advertisers gain from the programs.

573. Each observation in the Google Ads Log-Level Dataset represents an advertiser's bid in the Google Ads auction. The dataset contains all bids from a random 10% sample of internal auctions conducted between January 17, 2024 and January 23, 2024, inclusive. Altogether, this dataset contains bids for around [redacted] US AdX impressions.[1116] For each impression, the dataset contains estimates of the valuations of all bidders in the Google Ads internal auction, stored in the column "original_unadjusted_score_usd".

574. Because Corollary 1's technical condition applies to the true distribution of advertisers' values—which is not observable using the sample of data I have access to—I compare the *empirical* distributions of advertisers' values in those samples to value distributions that I *know* to be DHR in the relevant domain. To incorporate heterogeneity in

[1115] Google Ads Log-Level Dataset (January 2024), GOOG-AT-EDTX-DATA-000000000 to -000258388.

[1116] This statistic was calculated using code/misc_queries.py in my supporting materials, and the output is saved in code/logs/misc_queries.txt.

advertisers' values for different types of impressions, I examine **slices** of data in the Google Ads Log-Level Dataset, consisting of a group of Google Ads advertiser valuations for a given operating system, platform, browser, domain, GFP network ID, and inventory unit path.[1117] A slice is kept if it contains at least 100,000 bids with advertiser valuations and $1 of advertiser spend across those bids. For each slice, I evaluate the empirical distribution at 100 quantiles, so that each quantile has at least 1,000 affiliated observations.[1118]

575. For each slice, I identify a DHR distribution that closely approximates the empirical distribution of advertisers' values on the relevant set of values (namely, those above the publisher's optimal floor price under direct bidding). To do so, I first note that a distribution has decreasing hazard rate if and only if the log-survival function, $\log(1 - F)$, is convex.[1119] Thus, to approximate the empirical distribution, I compute the **convex envelope** of the empirical log-survival function: the pointwise maximum convex function that lower-bounds the empirical log-survival function on the values of interest. I then find the distribution whose log-survival function is equal to this convex envelope.

576. To implement this process computationally, I first find the optimal floor price for the empirical value distribution by computing the revenue a publisher would earn by setting each possible floor price and choosing the one with the highest revenue. I then compute the log-survival function $\log(1 - F)$ of the empirical distribution, keeping only the

[1117] Google Ads Log-Level Dataset (January 2024), GOOG-AT-EDTX-DATA-000000000 to -000258388.

[1118] These slices were generated using code/gads_bid_optimization_data.py and saved in code/gads_bid_optimization_data.json in my supporting materials. The number of slices is logged in code/logs/gads_bid_optimization_data.txt.

[1119] This is because the derivative of the log-survival function is the negative of the hazard rate: d/dx log(1-F(x)) = -f(x)/[1 - F(x)].

points between the optimal floor price and the 99th percentile.[1120] I find the convex hull of these points using a standard algorithm, keeping only the lower portion of the convex hull.[1121] Finally, I invert the transformation $F \mapsto \log(1 - F)$ to obtain a fitted DHR distribution.

577. To analyze the goodness-of-fit of the fitted DHR distribution, which I denote by $\hat{F}$, I compare it to its empirical counterpart F. For every value of *v*, $F(v) \leq \hat{F}(v)$ by construction. The area between the two curves over the support of *v* is a measure of distance called the Wasserstein metric or the "earth mover's distance." If the area between the two curves is large, the fitted DHR distribution fits the empirical distribution poorly. Conversely, a small area indicates a good fit.

578. On the vast majority of the data slices, it is possible to identify a DHR distribution that is practically indistinguishable from the empirical distribution of advertisers' values. This means that—for advertisers bidding on those kinds of impressions, which make up the vast majority of Google Ads advertisers—if Google Ads' bid optimization programs increased Google Ads' win rates, they must also have increased the surplus of Google Ads advertisers, even after accounting for the effects on publisher floor prices.

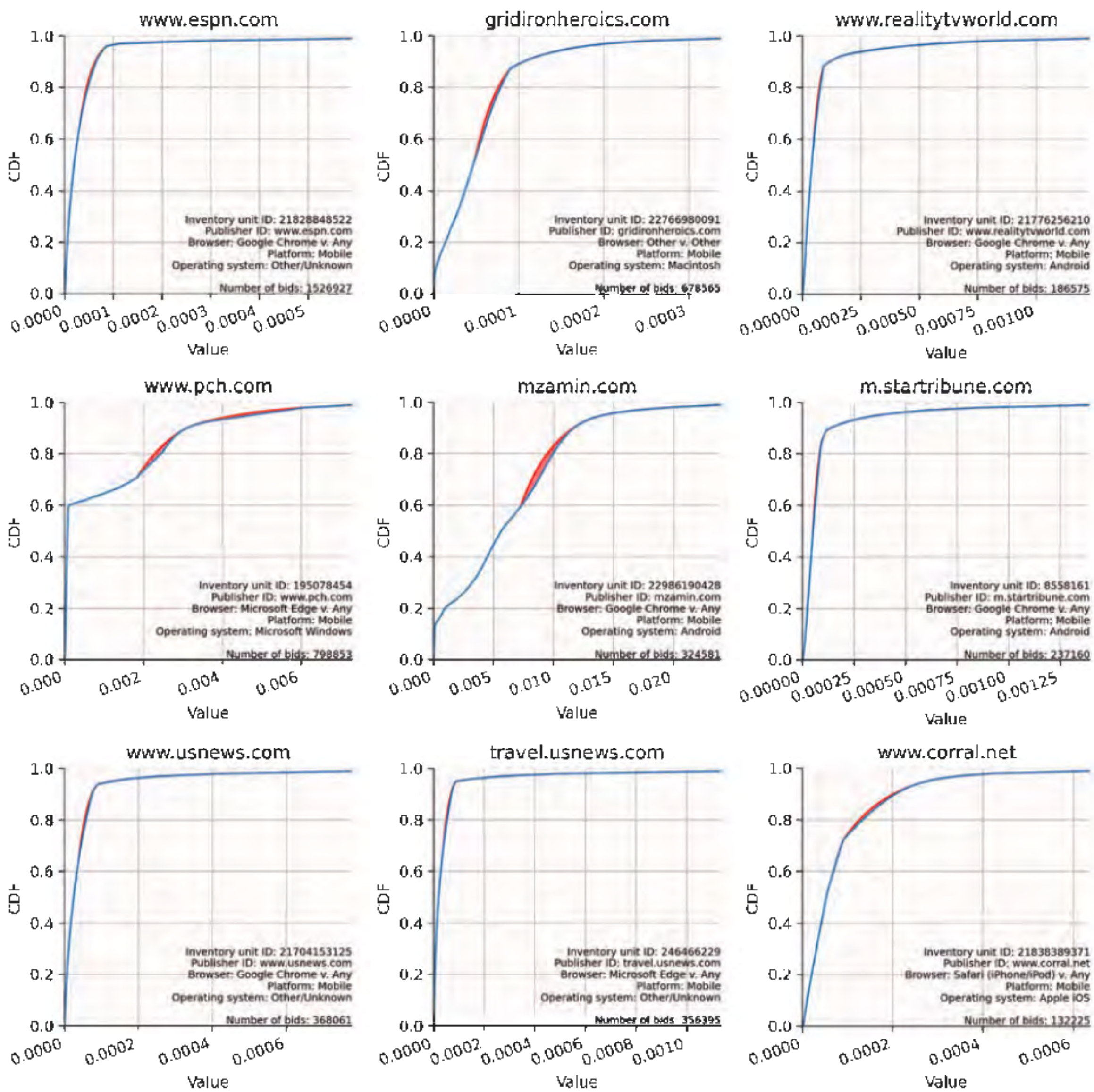
579. To illustrate how well the vast majority of the data slices on Google Ads' values can be fit to DHR distributions, I ordered each data slice according to my measure of its goodness-of-fit normalized by the optimal floor price under direct bidding.

[1120] I exclude the top 1% of values in this analysis because they are sampled too sparsely to accurately assess the shape of the true distribution in this region.

[1121] *See* Scipy, scipy.spatial.ConvexHull, SciPy v1.11.4 Manual (accessed Jan. 10, 2024), https://docs.scipy.org/doc/scipy/reference/generated/scipy.spatial.ConvexHull.html.

580. In Figure 16, I plot the empirical distribution of advertisers' values in the Google Ads Log-Level Dataset (in blue) and its fitted distribution satisfying DHR (in orange) for nine slices at the 2nd percentile of this goodness-of-fit measure. On these slices, the empirical distribution and the fitted distribution are practically indistinguishable (the blue curve hides the orange curve almost completely), and 98% of data slices fit better than those illustrated.

Figure 16: Empirical Distributions and Their Fitted DHR Distributions for Nine Slices at the 2nd Percentile[1122]

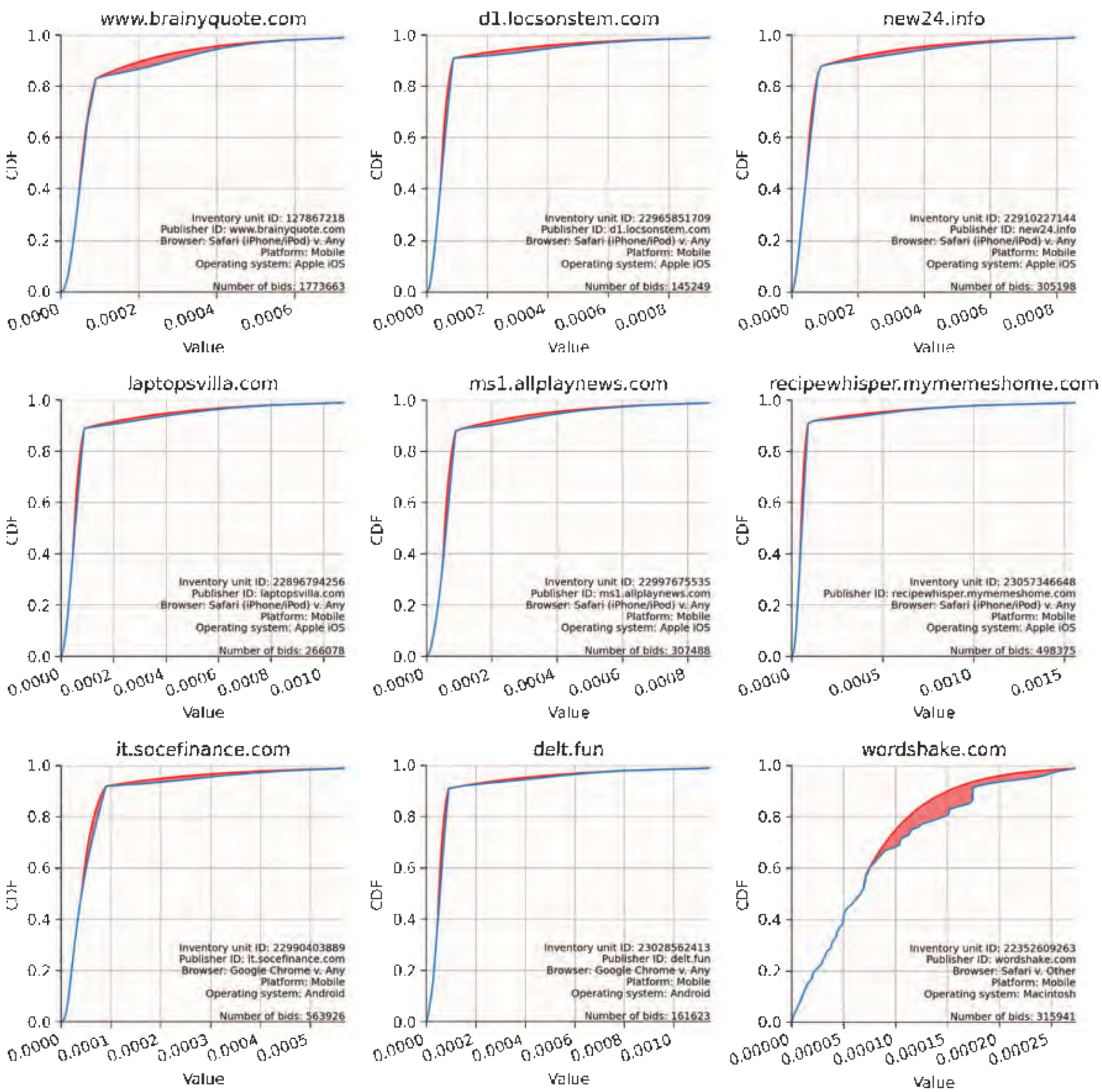


581. I provide similar plots for the nine *worst*-fit slices in Figure 17, showing that while there is some discrepancy between the empirical distribution and its fitted distribution and

[1122] The code to calculate the fits and generate Figures 16 & 17 can be found in code/gads_bid_optimization_fit.py. The figures can be found in code/figures and are prefixed with gads_bid_optimization_grid.

although the orange curve is no longer completely hidden by the blue curve in these plots, the fit is still extremely good.

Figure 17: Empirical Distributions and Their Fitted DHR Distributions for Nine Slices at the 0th Percentile



582. For each slice, define M^* as the solution to the following optimization problem:

$$M^* = max_{x(v),x'(v),r'} \int_r^v [x'(v) - x(v)]\, dF(v),$$

subject to:

a. $S = \int_r^v [x'(v) - x(v)]\lambda(v)\, dF(v) \leq 0,$

b. $x(v)$ and $x'(v)$ are non-decreasing functions,

c. $x(v) \in [0, 1]\, , x'(v) \in [0, 1]$ for all $v \in (r, \bar{v})$,

d. $x'(v) = 0 = x(v)$ for $v < r \leq r'$,

e. $x'(v) = 0 \leq x(v)$ for $r \leq v < r'$,

f. $x'(v) \geq x(v) \geq 0$ for $v \geq r'$.

583. If the first restriction does not bind, it is possible to attain $M^* = 1 - F(r)$, with $r' = r$, and $x(v) = 0,\ x'(v) = 1$ for all $v \in (r,\bar{v})$. However, $S = \int_r^v \lambda(v)\, dF(v)$ will be strictly positive unless $F(r) = 1$. Thus, if $F(r) < 1$, the first restriction binds and $M^* < 1 - F(r)$; otherwise, $M^* = 0$.

584. M^* is the minimum change in the Google Ads win rate that guarantees a non-negative change in the advertiser's *ex ante* expected surplus, because for all lower values of M it is feasible to achieve a negative surplus.

585. To approximate M^*, I take a grid of K values $v_1,\ v_2,\ ...\ ,\ v_K$, where v_k corresponds to the k/K quantile of the empirical distribution of valuations in the slice and denote by $\widetilde{F}(\cdot)$ the

empirical distribution of these K values. Therefore, $F(v_k) = \widetilde{F}(v_k) = k/K$ for all $k = 1, 2, \ldots K$. I define $a = \widetilde{F}(r) \times K$, $b = \widetilde{F}(r') \times K$, and $x(v_k) = \sum_{i=1}^{k} y_i$, $x'(v_k) = \sum_{i=1}^{k} y'_i$ and $R_k = \sum_{i=k}^{K-1} \lambda_i$, where $\lambda_i = (K - i)(v_{i+1} - v_i)$.[1123] I replace $F(v)$ by the empirical distribution of the the K values $v_1, v_2, \ldots, v_K$ in the formulas for M and S, which yields the following optimization problem:

$$M^* \approx max_{b,y,y'} \sum_{i=b}^{K} \frac{K-i+1}{K} y'_i - \sum_{i=a}^{K} \frac{K-i+1}{K} y_i ,$$

subject to:

$$\sum_{i=b}^{K} R_i y'_i - \sum_{i=a}^{K} R_i y_i \leq 0,$$

$$b \geq a \, , 0 \leq y_i \leq 1 \text{ and } 0 \leq y'_i \leq 1 \text{ for all } i,$$

$$\sum_{i=a}^{K} y_i \leq 1 \, , \sum_{i=b}^{K} y_i' \leq 1,$$

$$\sum_{i=a}^{h} y_i - \sum_{i=b}^{h} y_i' \text{ for } h \geq b.$$

For a fixed pair (a, b), this is a linear program with inequality constraints.

[1123] Note that this expression converges to the inverse hazard rate as the grid of values becomes dense.

586. To solve the optimization problem for each slice, I set the floor price r to maximize $[1 - F(r)]r$, which is known as the optimal or Myersonian floor price. I set $a = \widetilde{F}(r) \times K,$ and solve the program above solving a linear program for a grid of values $b = a, a + 1, \ldots, K$ and choosing the maximum solution.

587. When we set $K = 100$, in more than 95% of the data slices the increase in win rate that guarantees an increase in advertiser surplus, M^*, is less than 2%. This implies that the advertiser surplus in those slices must increase for an increase of 2% in win rate. The results for other values of M and K displayed in Figure 4.

588. This analysis suggests to me that, after accounting for the incentives for advertisers to adjust their bids and for publishers to adjust their floor prices in response to the programs, the vast majority of advertisers using Google Ads would have benefited from any of Google Ads' bid optimization programs that increased the Google Ads win rate.

B. Technical Notes for Simulations of Dynamic Allocation in Section VIII.E

1. Data

589. I use two main datasets in this simulation analysis.

a. *Google Ads Log-Level Dataset*:[1124] Each observation in this dataset represents an advertiser's bid in the Google Ads auction, which determines the bids that Google Ads will submit to AdX. The dataset contains all bids from a random 10% sample of internal auctions conducted between January 17, 2024 and January 23, 2024, inclusive. After filtering this dataset to observations related to US impressions for

[1124] Google Ads Log-Level Dataset (January 2024), GOOG-AT-EDTX-DATA-000000000 to -000258388.

which a bid was submitted into GAM, this dataset contains bids for around [redacted].[1125] For each impression, the dataset contains estimates of the valuations of all bidders in the Google Ads internal auction.

b. *Google Ad Manager Log-Level Dataset*:[1126] Each observation in this dataset represents a demand source's bid for an impression in the GAM Unified First Price Auction. The dataset contains all bids from demand sources in the same time period as the Google Ads Log-Level Dataset, in those auctions with a viewed winning candidate in the GAM UFPA.[1127] Altogether, this dataset contains bids for around [redacted].[1128] Each observation includes the *inventory unit* of the impression for sale (which is an identifier of the space on a publisher's website where the ad will be displayed), the amount the publisher would be paid if that bid were to win,[1129] and the floor price that the demand source faced when bidding for that impression. By applying the bid inversion technique with modifications as described in the Technical Notes in Section XV.B.4.b to these data, I estimate these bidders' valuations.

1125 My filtering only includes auctions with bids submitted into GAM (*i.e.*, where publisher_ssp is null and there is an internal auction winner). Of these auctions, 64 of them have multiple internal auction winners; I exclude such auctions from my analysis. Both the number of impressions and this statistic are computed in code/misc_queries.py in the supporting materials and is logged to code/logs/misc_queries.txt.

1126 Google Ad Manager Log-Level Dataset (January 2024), GOOG-AT-EDTX-DATA-000276098 to -001116097.

1127 Note the differences in the dataset sampling criteria: 1) the Google Ads dataset is a 10% sample, while the GAM dataset is not, and 2) the GAM dataset contains only auctions with a viewed candidate, while the Google Ads dataset does not have that restriction.

1128 The number of impressions was calculated using code/misc_queries.py in my supporting materials, and the output is saved in code/logs/misc_queries.txt.

1129 For remnant line item candidates, this amount may not necessarily be what the publisher is ultimately paid. *See* Letter from J. Elmer to J. Hogan (Mar. 31, 2022), GOOG-AT-MDL-007334120, at -121 ("In addition, for remnant line items, data for publisher payout is entered by publishers and does not necessarily correspond to the actual or agreed publisher payout amount, if the remnant line item wins.").

2. Selecting the Sample of Data from the GAM Log-Level Dataset

590. The GAM Log-Level Dataset contains many observations that are not relevant to my study of DA (for example, because they correspond to pre-auction transactions or correspond to impressions served to users outside of the relevant geographical region for this case). To remove irrelevant bids and auctions from my analysis sample, the GAM dataset is filtered as follows:[1130]

a. Auctions are limited to those where the end user had a country code of "US" and the field "is_youtube" is False.[1131]

b. All bids with win_loss values other than "Won" or "Lost" are removed, as those were bids rejected from consideration on the basis of price in their respective auction.

c. Only line items that directly compete in the GAM unified first-price auction are kept, specifically those with transaction_types of "Open Bidding" and "Open Auction".

d. Any remaining bid that is below its floor is removed. In the rare case that an auction's winning bid does not exceed its own floor, I discard the auction.

591. For each of the auctions remaining in the dataset, the bid associated with each demand source participating in the auction is calculated as p_view * (pub_payout_usd /

[1130] The data filtering and sample selection steps described in this section are done in code/gam.py in my supporting materials.

[1131] For this and subsequent references to code fields, I use the interpretations of the data fields in the Letter from D. Pearl to K. Garcia (Oct. 6, 2023), GOOG-AT-MDL-C-000012826.

max(views, 1)) and saved in a new column[1132] and bids are rounded to six decimal places, as is consistent with the precision of bids in GAM.[1133] If a demand source places multiple bids into the auction, only one bid is kept: the winning bid if the one of these bids won, and otherwise the highest of the losing bids.

592. For each bidder in each remaining auction, its **price-to-beat**—the minimum amount the bidder needed to bid in order to win the auction—is calculated as the maximum of the bidder's floor and the highest bid by an opponent and saved in a new column.

593. The remaining auctions are grouped by a **triple**, consisting of the publisher domain, inventory unit, and floor price associated with the impression in that auction. In order to ensure that each unit of my analysis is large enough to reliably conduct my simulations, a triple is included in the scope of the study if (i) it contains at least three "eligible" non-Google DSPs who each participated in at least 100,000 auctions and each accounted for at least 0.33% of the revenue in that grouping, and (ii) Google Ads participated in at least 100,000 auctions and accounted for at least 1% of the revenue in that grouping.

594. Heterogeneity is notable in these data: different publishers and inventory units experience different patterns of demand. In addition, because the auction run by GAM is a first-price auction, the bid for an impression might depend on floor prices, both for strategic reasons and because the floor price may reflect additional factors known to the publisher and bidders. To accommodate heterogeneity without additional assumptions, I obtain separate

[1132] This calculation is consistent with the [redacted] (Oct. 6, 2023), GOOG-AT-MDL-C-000012826, at -875, which notes that [redacted]

[1133] Letter from [redacted] (Dec. 7, 2023), GOOG-AT-MDL-C-000012885, at -893 ([redacted]

empirical estimates for each triple. I analyzed [redacted] inventory units across [redacted] publishers, comprising approximately [redacted] US publisher real-time bidding revenue in the January 2024 GAM data sample.[1134, 1135] I conducted a separate simulation for each of the resulting [redacted] triples (publisher, inventory unit, floor price).

3. Selecting the Sample from the Google Ads Log-Level Dataset

595. I collected pairs of highest and second-highest Google Ads values from all Google Ads internal auctions in which the query ID is contained in the GAM Log-Level Dataset and Google Ads bids into GAM (so that I could subsequently match observations between the datasets).

596. I required two values from Google Ads in my analysis: those associated with the winning internal bid and the internal bid with the highest non-winning unadjusted score.

597. For each bid, the advertiser's value is calculated by dividing the column "original_unadjusted_score_usd" by 1000. If there is no losing unadjusted score, the value for the highest losing bidder is taken to be zero. I remove all pairs where the highest value exceeds the 99.9th percentile value, because the calculated values above that quantile appear to be anomalies in the data.[1136]

[1134] In this statistic and others related to total publisher revenue, I exclude impressions won by "Reservation" and "HBYG," as I understand these aliases to potentially represent numerous, distinct sources of demand. Reservation creatives are associated with remnant line items, while HBYG is an alias for any header bids integrated using GAM's "Header Bidding Yield Groups" feature. *See* Letter from [redacted] GOOG-AT-MDL-007334131, at -134 ("Reservation refers to remnant line items."); *see also* George Levitte, "Improved header bidding support in Google Ad Manager," Google Ad Manager (Apr. 27, 2022), https://blog.google/products/admanager/improved-header-bidding-support-in-google-ad-manager/.

[1135] These statistics are computed in [redacted]

[1136] For example, some observations in the data have values over [redacted] CPM, which seem to be anomalies in the data set of advertisers' values. After applying the filtering described above, no values over $[redacted] CPM remain. This

4. Modeling Bidder Values

598. My model assumes that conditional on the observed triple of characteristics of the impression—the publisher, the inventory unit, and the floor price—bidders' values are statistically independent.[1137] This is a weaker assumption than the "independent private values" assumption made by Professor Weinberg[1138]: any model with independent private values must satisfy this conditional independence assumption. This assumption is consistent with standard practice for modeling display advertising auctions in the academic literature.[1139]

a) Values for AdX

599. For my simulations, I model bidders on AdX as consisting only of the bidders on Google Ads. In reality, many bids on AdX come from DV360 and Authorized Buyers, but I make this simplifying assumption for two reasons. *First*, I can *directly* observe a distribution of values of Google Ads advertisers, because I have access to these data for a subset of

restriction has the effect of reducing the revenue accruing to publishers from AdX, leading to a conservative estimate of the publisher's revenue from DA.

[1137] While I would not expect bidders' values for an impression to actually depend on the impression's floor price, allowing bidders to condition on the floor price captures some of the characteristics of the impression that are observable by bidders *and* publishers, but not included in the data.

[1138] Expert Report of M. Weinberg (Jun. 7, 2024), at ft. 62 ("I assume for the majority of this report that the advertisers have independent private values for impressions [...] and it is a sensible assumption to make").

[1139] *See* Balseiro, S. R., & Gur, Y. (2019). Learning in repeated auctions with budgets: Regret minimization and equilibrium. *Management Science*, *65*(9), 3952-68, at 3956 ("The information provided by the auctioneer heterogeneously affects the value advertisers perceive for the impression on the basis of their targeting criteria. The values advertisers assign to the impression they bid for […] are assumed to be independently distributed across impressions and advertisers"); Choi, H., & Mela, C. F. (2023). Optimizing reserve prices in display advertising auctions. Available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4523022, at 10 ("Following the symmetric independent private value assumption commonly adopted in prior work (*e.g.*, Ostrovsky and Schwarz 2011, Balseiro et al. 2015), advertiser valuations are assumed to be drawn independently and identically from the conditional distribution $F_V(v|z)$, where Z are auction specific observed covariates.").

impressions in the sample.[1140] This means that for Google Ads bidders, I have accurate estimates of values without needing to perform the "bid inversion" step that I describe below. *Second*, the Google Ads dataset also allows me to see the *two* highest values among bidders from Google Ads data. The second-highest bid on AdX is needed in order to simulate the second-price auction used with DA on AdX.[1141] Because this assumption omits some bidders, it underestimates the revenue accruing to publishers from AdX in each simulation and hence underestimates the revenues received by publishers under DA. I provide additional details about my approach to simulating AdX values in the Technical Notes in Section XV.B.3.

600. For each simulation, I first "flip a coin" that is weighted to match the participation probability of Google Ads observed in the log-level data for the corresponding triple of publisher-inventory unit-floor price.[1142] Conditional on the outcome of that coin toss, I draw a random pair of Google Ads valuations from the Google Ads Log-Level Dataset.

b) Bid Inversion to Estimate Values for Non-Google Demand Sources

601. For non-Google demand sources, I observe bids instead of values in the GAM log-level auction data, so I perform bid inversion to estimate the value distribution of the three largest eligible non-Google demand sources (by revenue) for each inventory unit. I allow the estimated value distributions to vary between demand sources.

[1140] [redacted] *See* Letter from [redacted], (Jun. 9, 2023), GOOG-AI-MDL-C-000012751 ("[redacted]").

[1141] I do not need data on the second-highest bids on other demand sources, because I do not model the internal auctions that may or may not be run on those demand sources, only the *net* bids they make.

[1142] I calculate the percentage of auctions in the triple for which Google Ads places a bid. Then, for each auction that I simulate, Google Ads draws a value with this probability.

602. I assume that demand sources generate most bids in the GAM data by first observing an advertiser's value and then selecting a bid that maximizes the advertiser's surplus, given bids expected for impressions sharing those characteristics. I assume that each demand source bids with a probabilistic assessment of their price-to-beat for the auction, which is the least bid that the bidder needs to make to win the auction. This probabilistic assessment is determined using a **cumulative distribution function** (CDF) $F(\cdot)$ that tells the demand source for each bid b the probability $F(b)$ that the bid wins the auction, with that CDF estimated using data from previous auctions. I assume that F is differentiable except at the floor price (at which there is an atom), so $F(b)$ is the probability that the maximum of the floor price and the highest other bid is less than or equal to b. The demand source selects a bid b for an advertiser of value v that maximizes the expression $(v - b)\, F(b)$.

603. Together, these assumptions imply that when a bidder bids b its value v for that impression is equal to $b + F(b)/f(b)$, where $f(b)$ corresponds to the probability density function (PDF) of the demand source's historical price-to-beat distribution.[1143] The distribution of bids observed in the GAM auction data can be used to infer $F(b)$ and $f(b)$, making it possible to recover a value that rationalizes each bid. The resulting estimates of the distribution of values do not rely on assumptions about the shape of the distribution of values and are specific to each demand source.

604. This methodology is standard for the empirical analysis of first-price auctions. However, it is also well known in the literature that this method cannot be applied blindly. To make

[1143] Since I assume that the price-to-beat has a differentiable CDF almost everywhere (with an atom at the floor price), the probability density function (PDF) can be calculated using the derivative of the cumulative density function.

sure that the results are robust, I need to apply some standard corrections to the inferred distribution of values in order to obtain bid functions that may be rationalized given the data and economic theory. In particular:

a. *Smoothing*: It is easier to estimate from the data the CDF of bids, $F(b)$, than the PDF, $f(b)$, which is the former function's derivative. In order to estimate this derivative reliably (*i.e.*, without creating spurious data artifacts), it is necessary to "smooth" the observed $F(b)$. I use a standard method for this smoothing called kernel density estimation (KDE).[1144, 1145]

b. *Truncation*: It is difficult to rationalize the very highest bids observed in the GAM data as surplus-maximizing bids by bidders with reasonable values for an impression.[1146] My interpretation of these very highest bids (the top 2% of bids) is that they are mostly associated with experimentation by bidders (or possibly a result of some bidding mistakes or responses to information I do not observe in my sample),[1147] and so, for the highest 2% of bids, I set the bidder value to be

[1144] *See* Guerre, E., Perrigne, I., & Vuong, Q. (2000). Optimal nonparametric estimation of first-price auctions. *Econometrica*, *68*(3), 525-574; Perrigne, I., & Vuong, Q. (2019). Econometrics of auctions and nonlinear pricing. *Annual Review of Economics*, *11*, 27-54.

[1145] Concretely, KDE spreads the probability mass of each data point in the empirical distribution of bids (log-transformed) over a small neighboring region according to a kernel function that integrates to one. I use the Gaussian density as a kernel function to obtain a smooth estimate of the density of the natural logarithm of bids. Then, by changing variables, I obtain the density of bids. The parameters of the Gaussian distribution are chosen using the inbuilt KDE procedure for SciPy (a popular Python library), which uses a heuristic due to Scott (1992) to choose the so-called *bandwidth* (which affects the standard deviation of the Gaussian kernel). *See* SciPy, "scipy.stats.gaussian_kde," SciPy v1.11.4 Manual (accessed Dec. 3, 2023), https://docs.scipy.org/doc/scipy/reference/generated/scipy.stats.gaussian_kde.html; Scott, D.W. (1992). *Multivariate density estimation: Theory, practice, and visualization*. John Wiley & Sons.

[1146] This is because in first-price auctions, very high bids do not substantially increase the probability of winning an auction but do substantially increase the amount that winning bidders must pay. The only way to rationalize very high bids is then with implausibly high values for impressions or by assuming that these bids are formed differently, for example as a result of experimentation.

[1147] [redacted]

equal to the value inverted for the bid at the 98th percentile of the bid distribution. The effect of this value-capping procedure on revenues and fill rates in my waterfall simulations is the same as restricting publishers to set their floor prices so that each demand source fills an impression at least 2% of the time it is called to bid.

c. *Enforcing monotonicity*: Economic theory tells us that surplus-maximizing bids must be *increasing* functions of these bidders' values, yet the estimation procedure described above sometimes results in small regions of values on which the estimated bidding function decreases. To deal with this, I use a procedure to impose monotonicity of the bidding function while still ensuring that each bidder's inferred value results in an observed bid that maximizes its expected profits from bidding.[1148]

605. Upon calculating these values, sampling from a demand source's value distribution is equivalent to first flipping a coin weighted as the participation probability of the demand source in the log-level data, and, conditional on the outcome of that coin, drawing a random value from the estimated values for that demand source.

2016), GOOG-DOJ-AT-02471119, at -120 ("[redacted]").

[1148] Concretely, for each value v on a grid, I find all bids that satisfy the *first-order* conditions for optimality, $v=b+F(b)/f(b)$, and then among those bids, I find the bid $b(v)$ that is the global maximizer of the expected utility $(v-b)F(b)$. Because $(v-b)F(b)$ exhibits increasing differences in values and bids (v,b) for any *CDF* $F(b)$, this procedure ensures that $b(v)$ is monotonic according to Topkis's theorem. *See* Milgrom, P., & Shannon, C. (1994). Monotone comparative statics. *Econometrica*, *62*(1), 157-180. I then use piecewise linear interpolation to obtain $b(v)$ for values between points in the grid. Only 3.7% of inferred values are changed by more than 10% as a result of this procedure to enforce monotonicity (logged in code/logs/parse_da_results.txt).

5. Simulating Sales of Impressions

606. After obtaining distributions of bidder values for each demand source, I then simulate the sales of impressions using both DA and the waterfall. To simulate such a sale, I randomly draw values for each of the non-Google bidders for the inventory unit from the estimated value distributions. I limit my attention to three non-Google demand sources for each auction, both for computational tractability and because the latency associated with calling more than three or four demand sources sequentially makes longer waterfalls impractical.[1149] For AdX, I draw a *pair* of values from the Google Ads value distribution. A pair of values is needed in order for me to simulate the outcome of the second-price auction used under DA. I adjust those advertisers' values for the Google Ads revenue share to determine bids into AdX. For each triple, I simulate 5,000,000 auctions.

a) Simulating the Waterfall

607. In the waterfall, the publisher calls a sequence of demand sources. In my simulations, when a demand source is called, it is offered the opportunity to buy the impression at a posted price. These posted prices are chosen separately for each demand source to maximize the publisher's expected revenues. If the value drawn for the demand source in the simulation exceeds the posted price, the demand source purchases the impression and pays the publisher the posted price. Otherwise, the request is passed to the next demand source in the waterfall, with the process repeating until the impression is sold or the list is exhausted (leaving the impression unsold). I select an order of the demand sources and

[1149] *See, e.g.*, Bidgear, "A Well Organized Passback Strategy," Bidgear Blog (Aug. 7, 2016), https://bidgear.com/blog/a-well-organized-passback-strategy-24 ("You don't want to make your waterfall chain too big because your site latency will suffer and some ads might time out.").

posted prices for each to maximize the publisher's total expected revenues using a dynamic programming procedure described in the Technical Notes in Section XV.B.6. By assuming that publishers set optimal posted prices, my simulation tends to overstate the revenues of the waterfall.

b) Simulating DA

608. To simulate DA, I assume that AdX first runs a second-price auction with a floor price *R* set by the publisher. If the highest AdX bidder's value for the impression exceeded the floor, the publisher would receive the larger of *R* and the second-highest AdX value; otherwise, the impression would be offered to non-Google demand sources using a waterfall. As in the other simulations, I calculate the optimal orderings and posted prices for the waterfall using a dynamic programming procedure described in Section XV.B.6. Calculating the optimal floor price *R* for AdX in this way is computationally difficult, so I instead assume (conservatively, as explained below) that publishers experiment to choose the floor price of AdX in DA, selecting the *R* from the following set of heuristics that leads to the largest average revenue:

a. The floor price AdX had faced in the counterfactual waterfall (if applicable),

b. The expected revenue from the waterfall,

c. 110% of the expected revenue from the waterfall, and

d. 125% of the expected revenue from the waterfall.

The waterfall described in heuristics b, c, and d refers to the procedure used when the highest AdX bid fails to exceed the floor. I include heuristics c and d because, according

to economic theory, the optimal floor price must be larger than the expected revenue from the waterfall. It is unlikely that any of these floor prices is the publisher's revenue-maximizing floor price for AdX, and switching to an optimal floor price would necessarily lead to higher publisher revenues. My reliance on the four heuristics just described tends to underestimate the benefits of DA for publishers.

c) Comparing DA and the Waterfall: Two Different Counterfactuals

609. I measure the effects of DA under two different counterfactuals:

a. *Counterfactual 1:* In the first counterfactual, I compare calling AdX with DA to a baseline in which the waterfall would *only* call three non-Google demand sources. In this counterfactual, enabling DA brings AdX as a new source of demand for publishers. I compare outcomes under this baseline waterfall to those that would have arisen if AdX were called with DA and, if AdX did not win the impression, the impression would be allocated through a waterfall containing just the two best non-Google demand sources.[1150]

b. *Counterfactual 2*: In the second counterfactual, I compare calling AdX with DA to a baseline in which the waterfall includes both AdX (not using DA) and non-Google demand sources. In this baseline waterfall, AdX and three non-Google demand sources all participate using publisher-optimal posted prices. I compare this baseline to the outcome of calling AdX with DA, followed by a

[1150] I reduce the number of non-Google demand sources in the DA simulation to ensure that any increase in publisher revenues caused by DA is not driven by an increase in the total number of demand sources that the publisher accesses. The counterfactual in which the publisher does not displace an existing demand source is covered in Section VIII.C: with an appropriate floor, DA is a *risk-free revenue improvement* for the publisher.

waterfall with the same three non-Google demand sources. This comparison isolates the effect of DA's introduction of auction-based pricing. This counterfactual is relevant for assessing whether DA improved outcomes compared to a baseline in which all demand sources competed on the same basis, using the waterfall.

6. Calculating Prices and Orders in the Waterfall

610. I calculate the order of each publisher's waterfall list and the prices for each demand source in the waterfall using a combination of search and dynamic programming.

611. Given a fixed ordering, to determine the optimal floor prices, I use dynamic programming. The fundamental challenge is that the optimal floor price for a demand source in the waterfall depends on the floor prices chosen for subsequent demand sources. So, to overcome this challenge, I first determine floor prices for the last demand source, *Z*, and then the second-last demand source, *Y*, and so on. For the last demand source, *Z*, I use a "grid search" to determine the optimal floor price, testing each of a grid of possible floor prices and finding one that maximizes the expected revenue (which equals the product of that floor price and the probability that a demand source has a value for the impression that exceeds that price). The expected revenue becomes the continuation value of not selling the impression to demand source *Y*. I then calculate the optimal floor price for *Y* in the waterfall by conducting another grid search, this time maximizing the publisher's expected revenue from selling the impression to *Y* or *Z*, by

incorporating the continuation value.[1151] Similarly, this maximized expected revenue becomes the continuation value of not selling the impression to the demand source before *Y*: demand source *X*. I continue to calculate floor prices in this fashion until I obtain a floor price for each demand source.

612. I consider each possible ordering of demand sources in the waterfall, calculating the optimal prices associated with that ordering (as described above) and the expected revenue for the publisher. For each waterfall, I choose the ordering of demand sources that results in the highest expected revenues for the publisher.

7. Simulation Results

613. I measured auction outcomes according to two metrics. The first is the average *publisher remnant revenue*. The second is the *match rate*, which is the fraction of impressions that are successfully sold before the waterfall is exhausted. Higher match rates mean that fewer impressions go unsold.

614. I first report the effects of DA under Counterfactual 1.[1152] I found that:

a. [redacted] of simulated publishers experienced revenue increases from DA, with total publisher remnant revenue increasing by [redacted]. The heterogeneity of those effects is plotted in Figure 9 and discussed in Paragraph 290. For the majority of publishers, the gains are substantial, with the median publisher experiencing a [redacted] increase in remnant revenue.

[1151] Mathematically, the objective of that grid search is the proposed floor price times the probability that the demand source's value exceeds that floor price *plus* the probability that the demand source's value does *not* exceed the floor price times the continuation value of not selling the impression.

[1152] All simulation results are computed in code/parse_da_results.py in my supporting materials and logged to code/logs/parse_da_results.txt.

b. DA lifted the overall remnant match rate from [redacted] leaving many fewer impressions unmatched.

615. In Counterfactual 2, I find that:

a. [redacted] of publishers experience revenue increases from DA, with overall publisher remnant revenue increasing by [redacted]. Heterogeneity in these effects is plotted in Figure 10 and discussed in Paragraph 291. The median publisher experienced a remnant revenue increase of [redacted].

b. Across all publishers, DA increased overall remnant publisher revenue match rates, from [redacted]

8. Robustness Checks

616. I ran additional simulations to check the robustness of these results to several of my modeling decisions and data inclusion criteria.

617. To check the robustness of my results to the value capping procedure described in Paragraph 604, I reran my simulations capping values at the 95th percentile and the 99th percentile. Under Counterfactual 1, the resulting increases in revenues under those alternative assumptions are [redacted]. Match rates increased from [redacted] (compared to from [redacted] Under Counterfactual 2, the resulting increases in revenues are [redacted] respectively (compared to [redacted] with the cap at the 98th percentile). Match rates increased from [redacted] nd from [redacted]

[redacted] These results all demonstrate the robustness of the conclusion that DA increases publisher revenues and match rates.[1153]

618. I set my inclusion criteria to include only triples for which there is enough data to reliably estimate values for each demand source. While my criteria allow me to incorporate a large portion of the data, less stringent criteria would have allowed me to achieve even more coverage (at the expense of less reliable estimates). To make sure that my results were not sensitive to my exact definition, I reran my experimental pipeline, this time requiring Google Ads and third-party demand sources to participate in only [redacted] auctions in a triple (instead of [redacted]. Doing so creates more eligible triples: with this less stringent criterion, there are [redacted] qualifying triples, comprising [redacted] of US publisher real-time bidding revenue in the GAM log-level data ([redacted][1154] Using these new triples, under Counterfactual 1, revenue increases by [redacted] and match rates increase from [redacted] Under Counterfactual 2, revenue increases [redacted] and match rates increase f[redacted]).[1155] Again, these results demonstrate the robustness of the conclusion that DA increases publisher revenues and match rates.

619. Another way I could have created the simulated auctions would have been to insert a step after running inversions and before sampling values in which all auctions that do not

[1153] These results were computed using code/parse_da_results.py in my supporting materials, with the numerical values logged in code/logs/parse_da_results.txt.

[1154] These statistics were computed using code/misc_queries.py in my supporting materials, with the numerical values logged in code/logs/misc_queries.txt.

[1155] These results were computed using code/parse_da_results.py in my supporting materials, with the numerical values logged in code/logs/parse_da_results.txt.

contain at least one of the inverted demand sources or Google Ads are removed. Doing so would increase the simulated participation rates of all demand sources, including Google Ads. With this added preprocessing step, under Counterfactual 1, revenue increases by [redacted] and match rates increase from [redacted] Under Counterfactual 2, revenue increases by [redacted] and match rates increase from [redacted][1156] Yet again, these results demonstrate the robustness of the conclusion that DA increases publisher revenues and match rates.

C. Technical Notes for Section IX (Enhanced Dynamic Allocation)

1. Further Details on Calculating the EDA Price to Maximize Publishers' Revenues While Fulfilling Guaranteed Contracts

620. Three major components are key to making EDA work: forecasting, computing the EDA price, and resolving ties between remnant line items. In this section, I focus on the original method EDA used to resolve such ties, called *randomized assignment*.[1157]

621. I illustrate randomized assignment using an example. Consider a publisher with 3,000 similar impressions to be allocated, of which 2,000 must be reserved for guaranteed contracts. When a publisher receives a bid of, say, $1, then to maximize its revenues, it

[1156] These results were computed using code/parse_da_results.py in my supporting materials, with the numerical values logged in code/logs/parse_da_results.txt.

[1157] *See* Design Doc, "Uniform Treatment for DFP Remnant and AdX under EDA" (Apr. 2019), GOOG-AT-MDL-011687180, at -180 to -181. As header bidding became more common, publishers increasingly used value CPMs to represent demand sources bidding in real-time. In this environment, EDA also increased expected publisher revenue compared to the pre-EDA procedure. Google later transitioned to a tie-breaking procedure I call "randomized bid perturbation," which could only increase publisher revenues further. *See* Design Doc, "Uniform Treatment for DFP Remnant and AdX under EDA" (Apr. 2019), GOOG-AT-MDL-011687180, at -182 [redacted]

should accept the bid unless it forecasts that there will be higher bids on at least 1,000 impressions in the future. Google's EDA program helps publishers to achieve this allocation by first forecasting future remnant bids and then using that forecast to estimate the highest price p such that there are at least 1,000 impressions receiving bids of at least p. I will call that p the "opportunity cost of not serving the guaranteed contract" or just the *market-clearing price*.

622. In auctions with multiple identical or similar items for sale, the total number demanded may exceed supply even at the market-clearing price. For example, suppose there are 950 impressions with bids higher than $0.50 and 75 with bids equal to $0.50. At any price higher than $0.50, there is less demand than the supply of 1,000 impressions for remnant bidders, while at a price equal to $0.50, there are 1,025 impressions demanded, which is 25 more than the available supply. This example highlights a common challenge for auctions with multiple similar units: the need for *tie-breaking*.

623. EDA resolved these ties with a procedure called *randomized assignment (RA)*. To illustrate randomized assignment, suppose that there is a group of 3,000 similar impressions and 2,000 of these need to be allocated to guaranteed contracts. Based on historical data, Google forecasts that [redacted] impressions will receive AdX bids larger than [redacted], and [redacted] of those will be larger than [redacted] Since there are only [redacted] remnant impressions to fill and Google knows that, just from AdX, it will receive at least [redacted] bids larger than [redacted], the market-clearing price is no less than [redacted]. This [redacted] minimum, which is computed using AdX bids only, was known as the EDA price.[1158] I denote it by p_{EDA}.

[1158] *See* Design Doc, "Uniform Treatment for DFP Remnant and AdX under EDA" (Apr. 2019), GOOG-AT-MDL-011687180, at -180 ("A distribution of AdX bids is built for each inventory slice in offline

624. Suppose that the highest remnant line item has a static bid of \$1.50. As the bid is static (it is a value CPM), the same bid price is applied to each impression. This means that the market-clearing price of each impression is $max(p_{EDA}, \$1.50)$.

625. EDA accepts all 500 bids from AdX that are larger than the market-clearing price (\$1.50) and must break ties to accept 500 of the 2,500 bids exactly at the price of \$1.50 (from the static remnant line item). [redacted]

626. The general idea is that EDA accepts the AdX bid when it exceeds *both* the remnant bid and p_{EDA}. When the remnant bid exceeds the AdX bid and p_{EDA}, then it wins with *just the right probability so that guaranteed contracts are fulfilled and revenue is maximized (subject to filling all the impressions with some ad).*[1160]

pipeline. Based on [redacted]").

[1159] *See* Design Doc, "Uniform Treatment for DFP Remnant and AdX under EDA" (Apr. 2019), GOOG-AT-MDL-011687180, at -180 to -181.

[1160] *For interested readers, this note illustrates the computation of "just the right probability so that guaranteed contracts are fulfilled."* Suppose that a remnant line item has a static bid of \$1.50 for all of a publisher's impressions in some group, that a fraction q of those must be reserved for guaranteed contracts, and that a fraction f of AdX bids are forecasted to be less than \$1.50. If $f < q$, then there are more than enough AdX bids higher than \$1.50 to serve all the non-guaranteed impressions, so no impressions are assigned to remnant demand. In that case, the market-clearing price is more than \$1.50. If instead $f > q$, then the publisher can earn more revenue by selling some impressions to the remnant line item: the market-clearing price for the publisher's relevant impressions is \$1.50. AdX bids greater than \$1.50 will win a fraction $1 - f$ of all the impressions. Of the remaining fraction f, q will be reserved for guaranteed contracts. So, to accept only the highest bids, $f - q$ should be assigned to the remnant line item with its bid of \$1.50 and the remaining such bidders should be rationed. To achieve that, when the remnant line item bids of \$1.50 are highest, they must be assigned an impression with probability $(f - q)/f$.

2. Theorem 2: Statement and Proof

627. **Theorem 2:** Suppose that publishers' guaranteed contracts are unchanged after the introduction of EDA and that Google accurately forecasts the distribution of future bids from AdX. Then (1) EDA increases the publisher's expected revenue relative to the pre-EDA allocation procedure, and (2) if publishers set the optimal floor price for the AdX auction ignoring direct contracts, the floor set by EDA *maximizes* publisher revenue.

628. ***Proof.*** We first prove part (1) of the Theorem.

629. Let q denote the estimated proportion of impressions that must be allocated to guaranteed contracts and F denote the cumulative distribution function of the highest bid from AdX (that is, $F(p)$ is the probability that the highest bid from AdX is less than or equal to p). I assume that F is continuous and has bounded density.

630. I use v to denote the value CPM of the most competitive non-guaranteed line item and µ for the average payment of this line item. Recall from the main text that $\mu \leq v$, as would be optimal for a publisher. Additionally, let $REV_{AdX}(a)$ denote the expected revenue from AdX *conditional* on the highest AdX bid exceeding its floor price a.

631. The following relevant properties of EDA were true at launch:

   a. The EDA price, p_{EDA}, is set so that $q = F(p_{EDA})$.

   b. The EDA algorithm was implemented as follows:

i. If AdX's bid exceeded the larger of p_{EDA} and v, then AdX won the impression.[1161]

ii. Otherwise, if $v \geq p_{EDA}$, then the impression was allocated to the non-guaranteed line item with probability $\frac{F(v)-q}{F(v)}$ and to the guaranteed contract otherwise.

iii. In any other case, the impression was allocated to the guaranteed contract.

632. The expected revenue per impression from indirect demand sources without EDA is $R_{pre-EDA} = (1 - q)[F(v) \cdot \mu + (1 - F(v)) \cdot REV_{AdX}(v)]$. In this expression, $(1 - q)$ is the probability that an impression is available to non-guaranteed buyers. It is multiplied by the term $[F(v) \cdot \mu + (1 - F(v)) \cdot REV_{AdX}(v)]$, where $F(v)$ is the probability that the highest AdX bid is less than the value CPM. Hence, $(1 - q)F(v)\mu$ is the expected revenue from remnant demand and $(1 - q)(1 - F(v))REV_{AdX}(v)$ is the expected revenue from AdX.

633. I now compute the expected revenue with EDA. There are two cases to consider.

a. First, consider the case where $v < p_{EDA}$. Then, all remnant impressions are sold to AdX, leading to expected revenues of $R = (1 - F(p_{EDA}))\ REV_{AdX}(p_{EDA})$. Since $q = F(p_{EDA})$, R is equivalent to $(1 - q)\ REV_{AdX}(p_{EDA})$. Also,

[1161] To simplify exposition, I assume there is no publisher-set AdX-specific floor price (or that any such floor price is smaller than the EDA price or *v*). The argument is similar if a larger AdX-specific floor price is present and *F* is appropriately adjusted to account for this floor.

$REV_{AdX}(p_{EDA})$ is greater than both v (and μ) and $REV_{AdX}(v)$ (since $p_{EDA} > v$), so $R \geq R_{pre-EDA}$ as desired.

b. Second, consider the opposite case where $v \geq p_{EDA}$. In this case AdX wins each impression with probability $(1 - F(v))$ and generates average revenue $REV_{AdX}(v)$ when it wins. A non-guaranteed line item wins with probability $F(v)\frac{F(v)-q}{F(v)} = F(v) - q$ and generates average revenue μ when it wins. In total, this means the expected revenue in this case is $R = (1 - F(v))REV_{AdX}(v) + (F(v) - q)\mu$, which may be rewritten as $R = ((1 - F(v))REV_{AdX}(v) + F(v)\mu) - q\mu$. Now I expand $R_{pre-EDA}$ to obtain $[(1 - F(v))REV_{AdX}(v) + F(v)\mu] - q[F(v)\mu + (1 - F(v))REV_{AdX}(v)]$.

Comparing the two expressions, one can observe that $R \geq R_{pre-EDA}$ if and only if $q(F(v)\mu + (1 - F(v))REV_{AdX}(v)) \geq q\mu$. The latter inequality holds because $REV_{AdX}(v) \geq v \geq \mu$ and hence $F(v)\mu + (1 - F(v))REV_{AdX}(v) \geq \mu$.

Hence, in both cases, the expected revenue from EDA, R, is no less than, $R_{pre-EDA}$.

634. We now show part (2) of the Theorem: if publishers set the optimal floor price for the AdX auction ignoring direct contracts, the floor set by EDA *maximizes* publisher revenue. Since—by assumption—Google accurately forecasts the distribution of bids from AdX, the EDA price is such that the $1 - q$ fraction of impressions allocated to

AdX remnant demand is *exactly* the set of impressions with the highest bids on AdX. This means there is no way to reallocate impressions between remnant demand and direct contracts to increase the bids received on remnant inventory. Additionally, as long as the floor price exceeds the static optimal reserve for that distribution (which is enacted by EDA under the assumption that publishers set the optimal static floor price, since EDA respects that floor as well), there is no way to increase the floor price to increase revenues on those impressions. Since there is no reallocation of impressions that increases bids received for remnant impressions and no change in the floor price that increases the remnant revenues conditional on those bids, there is no way to increase publisher revenues. This means that EDA maximizes publishers' remnant revenues under the assumptions of Theorem 2. ■

3. Analysis of pCTR Data: Supplemental Figures

635. Figure 18 and Figure 19 are analogous to Figure 12 and pertain to pAVR and pVTR, respectively.[1162]

Figure 18: Scatterplot of pAVR by publisher with/without EDA

[1162] These figures were generated by running the file code/pctr.py in my supporting materials. The figures are located at code/figures/pAVR_regression.png and code/figures/pVTR_regression.png, respectively.

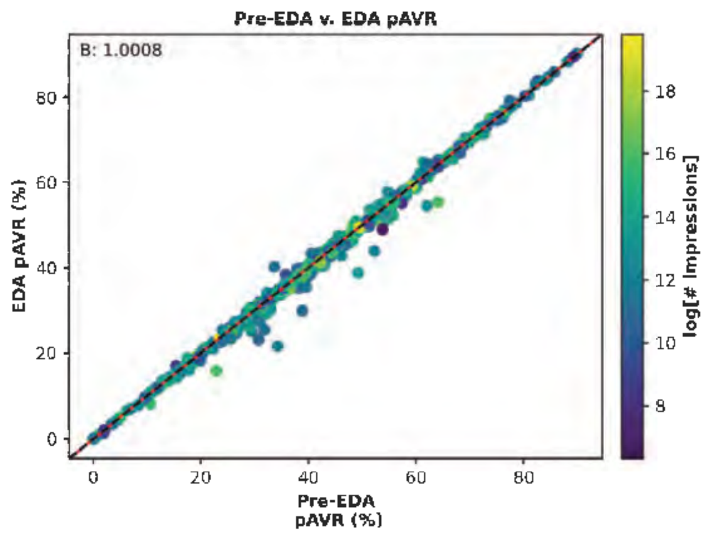
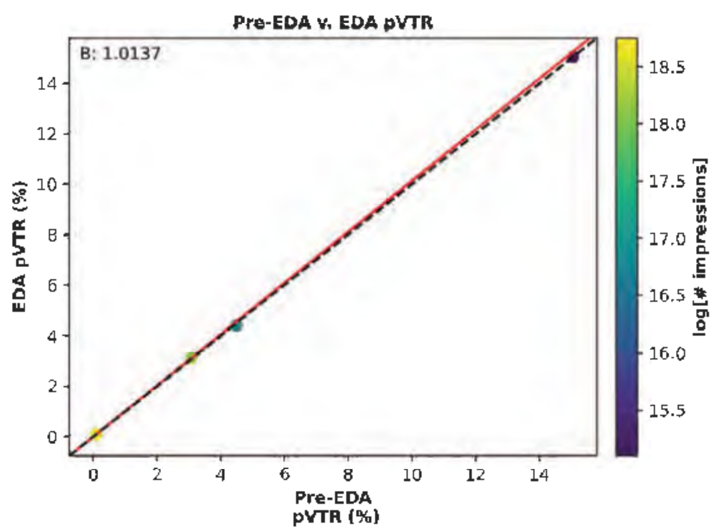


Figure 19: Scatterplot of pVTR by publisher with/without EDA



D. Technical Notes for Section X (Header Bidding and "Last Look")

1. Theorem 3: Statement and Proof

636. **Theorem 3:** Suppose that (i) a publisher sells an impression to a fixed set of bidders, including bidders on AdX, (ii) the publisher does not know each bidder's value for the

impression, (iii) bidders do not know each other's values for the impression, and (iv) all participants understand the rules and have the following information:

a. Each bidder knows its own value for the impression.

b. Each bidder's value is drawn from a commonly-known probability distribution[1163] and is statistically independent from other bidders' values.[1164]

c. Each bidder determines a bid as a function of its value to maximize its surplus from the impression, given its probabilistic assessments about the bids of other bidders.

Then, if the publisher chooses revenue-maximizing floor prices, it earns exactly the *same* expected revenue with a single unified second-price auction with all bidders participating as it would with first-price header bidding auction followed by a second-price auction for AdX.[1165] Moreover, given those optimal floor prices, each header bidder has the same chance of winning and the same expected surplus as an identical bidder on AdX.

637. ***Proof.*** This theorem is proved as a corollary of a well-known result from auction theory for this model: the *Payoff and Revenue Equivalence Theorem,* a version of which

[1163] I assume that this probability distribution F with density f satisfies a technical condition called "Myersonian regularity," which requires that the function $v \mapsto v - (1-F(v))/f(v)$ is increasing, and ensures that the optimal mechanism for selling the impression is an auction.

[1164] This implies that each bidder and the publisher can make a probabilistic assessment about other bidders' values and estimates of other bidders' values would not be changed upon learning one bidder's value.

[1165] More specifically, the theorem considers an auction game in which the publisher moves first, the header bidders second, and AdX bidders last. The publisher selects header bidding floor prices and a function to map each header bid it receives into a floor price for the AdX auction; the header bidders select their bids; and then finally the AdX auction is run.

states:[1166] *Suppose that bidders' values are independent and let r be any floor price.*[1167] *If bidders bid optimally, all auctions that award an item to the highest value bidder with bid above r lead to the same expected revenue for the seller and the same expected surplus for each bidder.*

638. By the Payoff and Revenue Equivalence Theorem, which applies under the assumptions of Theorem 3, if the publisher configures header bidding and its floor prices to ensure that the highest value bidder with value above the floor price r wins the auction, then its average revenue from that arrangement will be the same as for a unified second-price auction with floor price r and including all the same bidders.

639. To ensure that the highest value bidder with value above the floor price r wins the auction, the publisher could set a floor price of r in the header bidding auction and commit to choosing floor prices in the AdX auction as a function of the header bids received, as follows. Let $\beta(v)$ be the implied optimal bidding rule for header bidders, which determines for a bidder of value v its best bid $\beta(v)$ in the header bidding auction. It is a standard result that function β is increasing and, by the logic of bid shading into a first-price auction, $\beta(v) < v$.

[1166] *See* Milgrom, P. R. (2004). *Putting auction theory to work*. Cambridge University Press, at 73-77.

[1167] Roughly, bidders' values are independent if knowing the value of one bidder does not help predict the value of the other bidder. The same result holds if values are independent conditional on commonly observed information about the item. This "independent private value[s]" assumption is maintained by Plaintiffs' experts. *See, e.g.*, Expert Report of M. Weinberg (Jun. 7, 2024) at ft. 62 ("I assume for the majority of this report that the advertisers have independent private values for impressions [...] it is a sensible assumption to make since (a) internal Google documents demonstrate that Google assumes this as well (e.g., GOOG-AT-MDL-004016180), (b) bidders are heterogeneous in their valuation for impressions (the impression from an avid runner is valued differently by Nike and McDonald's) and since the bidders do not know each other's identities, even if they learn about others' bids it could possibly not be that useful towards determining their own valuation.").

640. There are two possibilities: first, if the highest bid in the header bidding auction is $B > r$, the publisher could estimate that the winning bidder has value $V = \beta^{-1}(B) > B > r$. If the publisher sets a floor price of V in the AdX auction, an AdX bidder wins only if it has the highest value (which is also higher than r). The second possibility is that there is no header bid exceeding the floor price r. In that case, if the publisher sets the floor price to be r for the AdX auction, a bidder wins only if it has the highest value and that value is larger than r.

641. With this floor pricing policy, in both cases, the winning bidder has the highest value among all bidders and that value is above the optimal floor price r. By the Payoff and Revenue Equivalence Theorem, this implies that the publisher obtains the same expected revenue and each bidder obtains the same expected surplus as for a unified second-price auction with floor price r (which is optimal among the class of all mechanisms for selling the impression). ■

E. Technical Notes for Section XII (Sell-side Dynamic Revenue Sharing)

642. In the following proofs, I assume that the standard sell-side revenue share of 0.8 is applied, otherwise each argument applies identically, replacing 0.8 with the negotiated revenue share.

1. Theorem 4: Statement and Proof

643. **Theorem 4:** If publishers did not change their floor prices and bidders did not change their bids, DRS v1 could only increase the number of impressions sold, publisher revenues, and buyer surplus.

644. ***Proof.*** For each impression, there are three possible scenarios under DRS v1: (1) AdX does not win the impression, (2) AdX wins the impression with its standard revenue share, and (3) AdX wins the impression with a lower revenue share. In the first two scenarios, the winner and their payment are the same with or without DRS v1: buyer surplus and publisher revenues are unchanged. In the third scenario, the impression sells on AdX when it would not have done in the absence of DRS, and the publisher receives revenue equal to the impression's floor price. As long as this floor price is no smaller than any header bidding or remnant demand offer for the impression, this implies that the publisher's revenue weakly increases. In this case, the buyer pays its bid, which can only increase its surplus, because a surplus-maximizing bidder chooses a bid less than its value. If a buyer bids its values—the optimal strategy for a single impression sold via a second-price auction—it would pay its value for the impressions sold by DRS v1, which would lead to a zero effect on buyer surplus. ■

2. Theorem 5: Statement, Proof, and Further Discussion

645. **Theorem 5:** Suppose that a publisher is selling an impression to a fixed set of bidders on AdX. The publisher does not know each bidder's value for the impression, and bidders do not know each other's values for the impression, but all participants have the following information:

a. Each bidder knows its own value for the impression.

b. Each bidder's value is drawn from a commonly known probability distribution and is statistically independent from other bidders' values.[1168]

[1168] This implies that each bidder and the publisher can make a probabilistic assessment about other bidders' values and estimates of other bidders' values would not be changed upon learning one bidder's value.

c. Each bidder determines a bid as a function of its value to maximize its surplus from the impression, given its probabilistic assessments about the bids of other bidders.

Then, if the publisher chooses revenue-maximizing floor prices, it earns a higher expected revenue on an impression to which DRS v1 is applied than it would without the program, and bidder surplus is unchanged.

646. ***Proof.*** This theorem is proved as a corollary of a well-known result from auction theory for this model: the *Payoff and Revenue Equivalence Theorem,* a version of which states:[1169] *Suppose that bidders' values are independent and let r be any floor price.*[1170] *If bidders bid optimally, all auctions that award an item to the highest value bidder with bid above r lead to the same expected revenue for the seller and the same expected surplus for each bidder.*

647. The Payoff and Revenue Equivalence Theorem implies that the exact method for determining payments (*e.g.*, first-price auction versus second-price auction) does not matter to determine the expected revenue—all that matters is the probability each bidder with a given value wins the impression.

[1169] *See* Milgrom, P. R. (2004). *Putting auction theory to work*. Cambridge University Press, at 73-77.

[1170] Roughly, bidders' values are independent if knowing the value of one bidder does not help predict the value of the other bidder. The same result holds if values are independent conditional on commonly observed information about the item. This "independent private value[s]" assumption is maintained by Plaintiffs' experts. *See, e.g.*, Expert Report of M. Weinberg (Jun. 7, 2024) at ft. 62 ("I assume for the majority of this report that the advertisers have independent private values for impressions [...] it is a sensible assumption to make since (a) internal Google documents demonstrate that Google assumes this as well (e.g., GOOG-AT-MDL-004016180), (b) bidders are heterogeneous in their valuation for impressions (the impression from an avid runner is valued differently by Nike and McDonald's) and since the bidders do not know each other's identities, even if they learn about others' bids it could possibly not be that useful towards determining their own valuation.").

648. Let r^* be the optimal floor price on a publisher's impression before the introduction of DRS. Before DRS, the publisher always earns [redacted] of the total revenue from sales, so, if the publisher optimizes the floor price, it must be the case that selling to the highest bidder with value greater than $r^*/$[redacted] maximizes the *total* revenue from the sales.

649. If the publisher sets a floor price equal to r[redacted] on an impression for which DRS v1 is active, the impression still sells to the highest bidder with value greater than the r[redacted]. The Payoff and Revenue Equivalence Theorem implies that the expected revenue is unchanged, and that this is the optimal floor price for the impression. Bidder surplus is also unchanged.

650. Since the total revenue is the same and AdX takes a lower revenue share on some impressions, the total earnings for the publisher *must increase*. ■

651. The statement and proof of Theorem 5 covers the case in which DRS v1 is active on an impression. In practice, AdX used probabilistic throttling to avoid reducing its overall revenue share too much, and as a consequence, buyers and publishers would need to consider the possibility of throttling when determining their optimal bids and floor prices. One simple solution for buyers would be to reduce their bids into the dynamic region only so often as to avoid being throttled by AdX. Buyers could monitor when AdX started to throttle their bids into the dynamic region and return to their pre-DRS strategies for some time. Another alternative would be for buyers to shade bids less to reduce their downward influence on revenue shares. Adapting bidding strategies in these ways would improve buyers' outcomes, and similar approaches could be taken by publishers. In either case, I would expect buyers and publishers to learn to adapt their strategies over time to

adjust for the possibility of throttling, and that publisher revenues would increase overall as a result of DRS v1, corresponding to Google's experimental results. In practice, AdX used [redacted] throttling probabilities for most buyers.[1171] Throttling may not have been necessary very often if buyers adapted their strategies to the presence of throttling or if many transactions were still cleared with the standard [redacted] revenue share because at least two bids were above the floor price.

3. Theorem 6: Statement and Proof

652. **Theorem 6:** Revenue for AdX under DRS v1 increases *only if* publisher revenues from AdX also increase. Additionally, every percentage increase in revenue for AdX results in a proportionally larger increase in revenue for publishers.

653. ***Proof.*** Let rev be the total revenue from sales before the introduction of DRS and $\widehat{rev}$ be the total revenue from sales after DRS v1. Let $prev =$ [redacted] rev be publisher revenues from AdX before DRS is introduced and $\widehat{prev} =$ [redacted] $\widehat{rev}$ be publisher revenues from AdX after DRS v1. Let $AdXRev =$ [redacted] rev be the AdX revenue before DRS and $\widehat{AdXRev} = 0.19\,\widehat{rev}$ be AdX revenue after DRS v1. Then $\frac{\widehat{prev}}{prev} =$ [redacted] This implies that for every [redacted] increase (or decrease) in AdX profits, publishers experience at least a [redacted]% increase (respectively, decrease) in revenues from AdX. (As noted above, I focus in this section on the [redacted] revenue share, but for publishers with different

[1171] *See* Presentation, "Dynamic Sell-Side Revshare[:] GDN/DRX Summit 2015" (Nov. 2, 2015), GOOG-DOJ-13202659, at -671.

negotiated revenue shares, the numbers appearing in this calculation would be different, although the general result remains unchanged.) ■

4. Technical Description of DRS v2

654. Let v_1 and v_2 respectively denote the highest and second-highest gross bids into AdX, and let bidder 1 and bidder 2 be the respective advertisers submitting these bids. Let r denote the floor price applying to the impression.

655. The auction allocation and pricing worked as follows under DRS v2:[1172]

a. Case 1: $r < v_1 \leq r/$[redacted]. AdX cannot win the auction with a fixed [redacted] per-impression revenue share, so it reduces its revenue share on the impression.

    i. Bidder 1 pays $(v_1 + r)/2$ to AdX.

    ii. AdX pays r to the publisher.

    iii. AdX updates the debt accounts for the publisher and the buyer. Bidder 1's debt increases by $\Delta_b = r/$[redacted]$- (v_1 + r)/2$, the amount it would need to raise its bid to win with a fixed [redacted]% revenue share. The publisher's debt increases by $\Delta_p = r -$ [redacted]$v_1 + r)/2$, the amount the floor price would need to lower by to sell with a fixed [redacted] revenue share.

b. Case 2: $r/$[redacted] $< v_1$. AdX may collect its standard revenue share on the impression and additionally recoup debts previously accrued by publishers and advertisers, while charging Bidder 1 less than its bid and paying the publisher more than the floor.

[1172] *See* Design Doc, "Dynamic Revenue Sharing (DRS) V2 Proposal" (Mar. 24, 2015), GOOG-DOJ-13221355, at -356 to -358; Launch Doc, "AdX Dynamic Revshare v2: Launch Doc" (Jan. 13, 2016), GOOG-DOJ-13207875, at -879 to -881.

i. Bidder 1 pays the standard price $max(v_2, r/$[redacted] plus a debt payment Δ_b to AdX. Δ_b was chosen to ensure that it was never more than the advertiser's outstanding debt balance and the buyer never paid more than its bid v_1 (in fact, never more than half of the buyer surplus in the absence of debt reclamation). Moreover, if the buyer set its *own* price (by submitting a second bid or nonzero "minimum payment"), any payment the buyer made in excess of $r/$[redacted] would be deducted from its debt. This served as an incentive for buyers to submit second bids.

ii. AdX pays the publisher the standard price max[redacted]$v_2, r)$ plus a share of the advertiser's debt payment [redacted]$_b$ minus a publisher debt payment Δ_p. Δ_p was never more than the publisher's debt balance and was chosen to ensure that the payment to the publisher was at least the floor r.

c. Case 3: if $v_1 \leq r$, AdX does not win the auction and no payments are made.

5. Lemma 1: Statement and Proof

656. **Lemma 1:** Suppose that AdX recoups all debts under DRS v2. Then, buyers accrue the full debt on each impression (equal to the difference between the floor price that would apply in the absence of DRS and the price it pays under DRS v2) and, after accounting for the payment of buyer debt to publishers, publishers accrue zero debt on net in expectation.

657. ***Proof.*** If all debts are repaid, the total debts paid by publishers equal the total debts they accrue on impressions sold via DRS v2 minus [redacted] times the total debts paid (and accrued)

by buyers. But on each individual impression, the debt accrued by a publisher is equal to [redacted] times the debt accruing to a buyer. Therefore, the net debt paid by publishers on impressions sold due to DRS v2 equals zero. Since buyers are never paid part of the publishers' debts, if all debts are repaid, the buyer pays the full debt it accrues on each impression sold due to DRS v2. ■

6. Theorem 7: Statement and Proof

658. **Theorem 7:** If publishers do not change their floor prices and buyers do not change their bids, then DRS v2 can only increase the total number of impressions sold and total publisher revenues compared to the absence of DRS.[1173]

659. ***Proof.*** Prior to DRS v2, publishers sell exactly the impressions where the highest bid v_1 clears the pre-revenue share floor $r/$[redacted] and the publisher earns the larger of r and [redacted]v_2 on each such impression. The revenue earned on each such impression is unchanged after the introduction of DRS v2.

660. With DRS v2, the publisher also earns a revenue of r from AdX on impressions for which the highest bid v_1 is between r and $r/$[redacted] (as argued above, the publisher can ignore the debts accrued which cancel out on average). The effect of these additional sales on the publisher's revenue with DRS v2 depends on the nature of the floor r. If r is exactly the price at which the publisher would otherwise sell the impression to an alternative exchange, its revenue is unchanged. Otherwise, if r is a publisher-set floor price (so that the impression would be otherwise unsold) or if r reflects the optimal floor

[1173] I assume that AdX performs enough transactions that all debts in DRS v2 are resolved.

price determined by the publisher given the header bids received, the publisher's revenue strictly improves with DRS v2. ■

7. Theorem 8: Statement and Proof

661. **Theorem 8**: If buyers and publishers set bids and floors to maximize their payoffs after the introduction of DRS v2, then buyer surplus and publisher revenues are the same as in the absence of DRS.

662. ***Proof.*** As Lemma 1 showed, buyers pay debt on each impression sold by DRS v2 equal to the difference between the pre-revenue share floor ($r/$[redacted] and the price paid for the impression. This means that the effective price of an impression cleared by DRS v2 for an advertiser is the pre-revenue share floor $r/$[redacted] As a consequence, buyers should only seek to win an impression if they value the impression above $r/$[redacted] Because each buyer always pays the larger of the second-highest bid and the floor if its bid is larger than $r/$[redacted] the optimal bidding strategy to bid truthfully.[1174] Consequently, for any fixed floor price, the auction's outcome is the same in the second-price auction as it is with DRS v2, and thus the optimal floor prices under DRS v2 are the same as in the absence of DRS v2. Therefore, once buyers and publishers fully adapt their strategies to DRS v2, the total publisher revenues and AdX profits should equal those quantities *before* the introduction of DRS. ■

[1174] To see this, suppose that there was any positive probability that a bidder bid into the dynamic region. Then any such bidder could increase its probability of winning without changing the price it paid by increasing its bid to r/[redacted]. But for bids of [redacted] or larger, the auction is the same as a second-price auction, which means that each bidder's optimal strategy is to bid truthfully.

8. Technical Description of tDRS

663. The tDRS program worked as follows:

a. AdX observed the publisher-set floor price and the value CPMs associated with any remnant demand line items. The maximum of these values was AdX's floor price r.

b. Before offering the impression to buyers, AdX compared the pre-revenue share floor price, $r/$[redacted] to the Reserve Price Optimization (RPO) program's reserve r^*, which was the floor price that AdX predicted would maximize the publisher's expected revenues from AdX.

c. If the pre-revenue share floor [redacted] exceeded the RPO reserve r^* for that impression and AdX predicted that it was unlikely for there to be a buyer with value larger than $r/$[redacted] then AdX sent a floor of r with a 0% revenue share on the impression to its buyers, increasing the probability that a sale will occur.

i. If there was a bid above the floor r and the second-highest bid was less than $r/$[redacted] then the publisher was paid r and accrued a "debt" of 0.[redacted] representing the revenue share foregone by AdX on that impression.

ii. If there were two bids above $r/$[redacted], then the winning buyer would be charged the second-highest bid and AdX would take its standard [redacted] revenue share: in this case, payments were the same as in the absence of DRS. No "debt" was accrued.

d. Otherwise, if $r/$[redacted] was larger than the RPO reserve r^* but AdX predicted it to be likely that there was a buyer with a larger value than $r/$[redacted] then AdX maintained its [redacted] per-impression revenue share and the impression transacted per usual.

e. Finally, if $r/$[redacted] was less than the RPO reserve r^*, then r^* became AdX's floor price. If the impression sold with this RPO reserve and the publisher had previously accrued debt from a DRS transaction, some debt was repaid on this impression, no larger than the difference between r^* and r.

9. Theorem 9: Statement, Proof, and Further Discussion

664. **Theorem 9:** If publishers adjust their floor prices on AdX to maximize profits after the introduction of tDRS and tDRS accurately predicts buyers' bids, total publisher revenues from all demand sources will be higher with tDRS than with a fixed revenue share.

665. ***Proof.*** Suppose that in the absence of tDRS, a publisher sets a floor r for AdX. Without DRS, the impression is sold if there is some buyer willing to pay at least the pre-revenue share floor, $r/$[redacted]

666. Now suppose that tDRS is introduced. I show that the publisher can choose a floor price that guarantees them at least the same revenue as in the absence of DRS. This implies that if the publisher sets its floor prices optimally, its revenue must be even larger.

667. Suppose that the publisher reports a floor of r[redacted] to AdX, which is the pre-revenue share floor in the absence of tDRS. Then there are two possibilities:

a. tDRS applies a [redacted] per-impression revenue share, which means it predicts that there will be a buyer who can beat the new pre-revenue share floor, $r/$[redacted]. If the tDRS prediction model is accurate, the publisher earns at least $r/$[redacted] for these impressions, more than it did in the absence of DRS.

b. tDRS predicts that there will not be an AdX buyer who can beat the price $r/$[redacted] and applies a 0% per-impression revenue share. In this case, the AdX buyer wins the impression if it bids above the floor price of $r/$[redacted] exactly the same as the pre-revenue share for advertisers before DRS. Because tDRS incentivizes truthful bidding, the AdX buyer wins the impression if and only if it would win it without tDRS. In this case, the payment to the publisher for the impression is r[redacted] and the publisher accrues a "debt" of 0.[redacted], leading to a net payoff of r. The expected publisher revenue is therefore unchanged by tDRS.

668. Thus, the impression sells with the same probability under tDRS as without DRS, and the publisher earns more revenue than without DRS.[1175] Under the optimal floor price, which may differ from $r/$[redacted] the publisher can only receive even higher revenues. ∎

669. Although an assumption of Theorem 9 is that AdX is perfectly able to predict whether its buyers will clear a given floor price, the same conclusion holds as long as (1) AdX predicts bids better than publishers and (2) the revenue share under tDRS maximizes Google's expected profits (or, equivalently, the expected revenues of the publishers).

[1175] In this analysis, I have fixed the bids of header bidders after the introduction of tDRS. In general, header bidders need to account for the change of format in the AdX auction because it may affect their expected payoff of any given bid. However, because under the posited strategy of reporting floor r/0.8, there is no change in the probability of sale on AdX, the header bidders' bids should not change either. Under the publisher's optimal strategy, however, header bidding advertisers' bids would change, but this does not affect the conclusion of Theorem 9.

F. Technical Notes for Section XIII (Open Bidding)

1. When Publishers Boost Bids in Professor Weinberg's Own Example, Publisher Revenues are Identical to a Unified Auction and Neither Bidder Has an "Advantage"

670. I consider Professor Weinberg's example in Appendix D of his report in which there are two bidders "in the independent private values model" with "values are each drawn independently and uniformly from [0,10]."[1176] In Professor Weinberg's example, the "two bidders participate in a first-price auction, but one bidder [(Bidder One)] learns the others' bids [(Bidder Two)] before bidding."[1177] I show that when the publisher boosts the bids of Bidder Two by a factor of two, it achieves the same revenues as it would in a unified auction, while leaving neither bidder with an "advantage."

671. After Bidder Two's bid is doubled, that boosted bid serves as a floor price in a first-price auction with Bidder One. Hence, in this example, Bidder One maximizes its surplus by submitting a bid equal to the boosted bid of Bidder Two when its value exceeds the boosted bid. Bidder Two determines how much to bid by optimizing its expected surplus, $(v - b)Pr\{v_{Bidder\ One} \leq 2b\}$. Maximizing this expression with respect to b implies that it submits bids equal to $b = v/2$.

672. *First,* notice that Bidder Two wins if and only if its value is larger than Bidder One's value. When combined with the fact that both bidders' valuations are drawn from identical uniform distributions, this implies that each bidder has win probability equal to $\frac{1}{2}$.

[1176] *See* Expert Report of M. Weinberg (June 7, 2024) at Appendix D, ¶ 6.

[1177] *See* Expert Report of M. Weinberg (June 7, 2024) at Appendix D, ¶ 5.

673. *Second,* the publisher achieves revenues of

$$E[v_{Bidder\ 2} \mid v_{Bidder\ 1} \geq v_{Bidder\ 2}]\, Pr\{v_{Bidder\ 1} \geq v_{Bidder\ 2}\} +$$

$$E[1/2v_{Bidder\ 2} \mid v_{Bidder\ 2} > v_{Bidder\ 1}]\, Pr\{v_{Bidder\ 2} > v_{Bidder\ 1}\},$$

as Bidder 1 pays the bid of its competitor when it wins, while Bidder 2 pays its own bid when it wins. Simplifying this expression further yields

$$\frac{1}{2} E[v_{Bidder\ 2} \mid v_{Bidder\ 1} \geq v_{Bidder\ 2}] + \frac{1}{2} E[1/2v_{Bidder\ 2} \mid v_{Bidder\ 2} > v_{Bidder\ 1}] = 3\frac{1}{3}.$$

674. *Third,* notice that each conditional expectation in the previous expression is equivalent. Namely, that,

$$E[v_{Bidder\ 2} \mid v_{Bidder\ 1} \geq v_{Bidder\ 2}] = 3\frac{1}{3} = E[1/2v_{Bidder\ 2} \mid v_{Bidder\ 2} > v_{Bidder\ 1}].$$

Hence, the bidders' average payments are the same.

675. As Professor Weinberg notes in Lemma 3 of his Appendix D, this revenue is identical to the expected revenue in the unified auction with two bidders.[1178]

2. Extending Professor Weinberg's Example Shows that the So-Called "Last Look" Does Not Inherently Decrease Publisher Revenues, Even When Publishers Do Not Boost Header Bids

676. Consider a simple extension of Professor Weinberg's example, with the following two buyers:

[1178] Expert Report of M. Weinberg (June 7, 2024) at Appendix D, ¶ 13 ("With two bidders whose values are each drawn independently and uniformly from [0,10], the sealed bid first-price auction achieves an expected revenue of 10/3").

a. *Buyer One* is an exchange that commits to running a second-price auction and receives bids from two bidders with independent and uniform values over [0, 10]. This assumption differs from Professor Weinberg's as it adds a second bidder to better understand the revenue effects in a second-price auction.

b. *Buyer Two* is a buyer that has independent and uniform values over [0, 10]. This assumption is identical to Professor Weinberg's.

For the sake of comparison, in this example, I adopt Professor Weinberg's assumption that the publisher does not set a floor price.

677. *First*, consider the case in which Buyer One has no "last look" and passes its internal clearing price to a first-price auction between Buyer One and Buyer Two. Given that Buyer One runs a second-price auction, the bid function for each bidder in Buyer One is $b_{Buyer\ 1,\ Advertiser\ i}(v) = v$. On the other hand, when Buyer Two has a valuation of *v*, it best-responds by submitting the bid *b* that maximizes its expected surplus:

$$U_{Buyer\ 2}(v,\ b) = (v - b)\,(1 - Pr\{Buyer\ 1\ Wins\})$$

$$= (v - b)\,(1 - Pr\{v_{Buyer\ 1,\ Advertiser\ 1} > b,\ v_{Buyer\ 1,\ Advertiser\ 2} > b\})$$

$$= (v - b)(1 - (1 - F(b))^2)$$

$$= (v - b)(1 - (1 - (b/10))^2)\ .$$

For any *v*, the optimal bid for that *v* must satisfy the first-order condition

$\frac{\partial U_{Buyer\ 2}(v, b)}{\partial b} = 0$, where

$\frac{\partial U_{Buyer\,2}(v,b)}{\partial b} = (v - b)(\frac{1}{5}(1 - \frac{b}{10})) - (1 - (1 - (b/10))^2)$. Solving for

$\frac{\partial U_{Buyer\,2}(v,b)}{\partial b} = 0$ and requiring $b \leq v$ over $v \in [0, 10]$ yields:

$$b_{Buyer\,2}(v) = \frac{1}{3}\left(v + 20 - \sqrt{v^2 - 20v + 400}\right)$$

From these two bidding functions, a simulation of 100,000,000 auctions estimates that the expected publisher revenue is 3.920.[1179]

678. *Next*, consider when Buyer Two bids first and that bid serves as the floor price for the bidders of Buyer One. Given that Buyer One runs a second-price auction, the bid function for each bidder in Buyer One is $b_{Buyer\,1,\,Advertiser\,i}(v) = v$; the floor price does not change a bidder's optimal bid in a second-price auction. On the other hand, when Buyer Two has a valuation of *v*, it best-responds by submitting the bid *b* that maximizes its expected surplus:

$$U_{Buyer\,2}(v,\, b) = (v - b)\, Pr\,\{Buyer\ 2\ Wins\}$$

$$= (v - b)\,(Pr\,\{\,b > v_{Buyer\,1,\,Advertiser\,1}\ b > v_{Buyer\,1,\,Advertiser\,2}\})$$

$$= (v - b)F(b)^2$$

$$= (v - b)(b/10)^2$$

[1179] This result was calculated using code/ob_example_extension.py in my supporting materials, and the output is saved in code/logs/ob_example_extension.txt.

Solving for $\frac{\partial U_{Buyer\,2}(v,b)}{\partial b} = \frac{1}{5}(v - b)\frac{b}{10} - (b/10)^2 = 0$ yields $b_{Buyer\,2}(v) = \frac{2}{3}v$.

From these two bidding functions, a simulation of 100,000,000 auctions estimates that the expected publisher revenue is 4.568, a 16.5% increase over the former case.[1180]

G. Technical Notes for Section XIV

1. An Example of Post-Auction Discounts Compared To Exchange-Discriminatory Floor Prices

679. I adapt the example used by Professor Weinberg in which there is a single AdX advertiser with value V_{AdX} distributed uniformly between 12 and 16, and a single OpenX advertiser with value V_{OpenX} distributed uniformly between 10 and 12.[1181, 1182]

680. The optimal mechanism can be obtained using the standard result of Myerson (1981) which calls for allocating the impression to the bidder with the highest marginal revenue as long as it is positive.[1183] The marginal revenues are given by $MR_{AdX}(V_{AdX}) = 2V_{AdX} - 16$, and $MR_{OpenX}(V_{OpenX}) = 2V_{OpenX} - 12$.

681. Note the marginal revenues are always positive in the relevant ranges. Thus, the optimal mechanism always calls for allocating the impression. Next we compare the marginal

[1180] This result was calculated using code/ob_example_extension.py in my supporting materials, and the output is saved in code/logs/ob_example_extension.txt.

[1181] Expert Report of M. Weinberg (June 7, 2024) at ft. 248 ("To make this example mathematically rigorous, imagine that there is a single AdX bidder whose value is distributed uniformly on [12,16], and there is a single OpenX bidder whose value is distributed uniformly on [10,12]. In this case, the revenue-optimal personalized reserves are $13 on AdX and $10 on OpenX. Moreover, the example bids for AdX and OpenX are optimal in this case.").

[1182] Code for computing the integration steps in this example can be found in code/post_auction_discounts_example.py in my supporting materials, and the output is saved in code/logs/post_auction_discounts_example.txt.

[1183] Myerson, R. B. (1981). Optimal auction design. *Mathematics of Operations Research*, *6*(1), 58-73.

revenues to determine who to allocate the impression to. The marginal revenues are equal when $2V_{AdX} - 16 = 2V_{OpenX} - 12$, or equivalently $V_{AdX} - V_{OpenX} = 2$.

682. This implies that the optimal mechanism allocates the impression to the AdX bidder if and only if its value is at least \$2 higher than the value of the OpenX bidder and to the OpenX bidder otherwise. This allocation can be implemented with a second price auction with a \$2 post-auction discount for the OpenX bidder. In this auction, it is a dominant strategy for the AdX bidder to bid its value and for the OpenX bidder to bid its value + \$2. The expected revenue from this auction can be calculated as

$$\int_{12}^{16}\int_{10}^{12}\left(max\left\{2V_{AdX} - 16, 2V_{OpenX} - 12\right\}\frac{1}{8}\right)dV_{OpenX}dV_{AdX} = 12.333.$$

683. The expected revenue that would be attained with the two reserve prices of \$10 for OpenX and \$13 for AdX suggested by Professor Weinberg would be

$$13 * \frac{16-13}{4} + \left(1 - \frac{16-13}{4}\right) * 10 = 12.25.$$

684. Thus, publishers would be *strictly* better off using a post-auction discount of \$2 with a common reserve price of \$12 than using two different reserve prices.

685. To adapt this analysis to the context of a first-price auction (as in the UFPA) I will demonstrate that a post-auction discount of \$2 for OpenX (with a uniform reserve price of \$12 or less) continues to deliver a higher expected seller revenue than setting two reserve prices.

686. The analysis uses the derivation of optimal bidding strategies in the asymmetric first-price auction case found in Kaplan and Zamir (2012).[1184] It is convenient to start by re-writing the values as $V_{AdX} = 12 + Uniform\,[0, 4]$ and $V_{OpenX} + \$2\,discount = 12 + Uniform\,[0, 2]$.

687. The bidding strategies can be obtained by inverting equations (20) and (21) in Kaplan and Zamir (2012),[1185] using the distributions $Uniform\,[0, 4]$ and $Uniform\,[0, 2]$ and then adding $12. Doing that, I obtain

$$b_{AdX}(V) = \frac{1}{3V}\left(4\sqrt{3V^2 + 16} - 16\right) + 12\text{, and}$$

$$b_{OpenX}(V) = \frac{2}{3V}\left(8 - 2\sqrt{16 - 3V^2}\right) + 12\,.$$

The expected gross revenue is then given by the following integral

$$12 + \int_0^2\int_0^4\left(max\left\{\frac{1}{3V_{AdX}}\left(4\sqrt{3V_{AdX}^2 + 16} - 16\right), \frac{2}{3V_{OpenX}}\left(8 - 2\sqrt{16 - 3V_{OpenX}^2}\right)\right\} * \frac{1}{8}\right)dV_{AdX}dV_{OpenX},$$

which when computed, obtains $GR = 12.91801$.

688. The last step is then to subtract the post-auction discounts that need to be rebated to OpenX. For this, we compute the probability of winning for OpenX which is simply the probability that $b_{OpenX} > b_{AdX}$, which can be shown to be $\frac{1}{3}$. Thus, we subtract $\frac{1}{3} * 2$

[1184] Kaplan, T. R., & Zamir, S. (2012). Asymmetric first-price auctions with uniform distributions: analytic solutions to the general case. *Economic Theory*, *50*(2), 269-302.

[1185] Kaplan, T. R., & Zamir, S. (2012). Asymmetric first-price auctions with uniform distributions: analytic solutions to the general case. *Economic Theory*, *50*(2), 269-302.

from the gross revenue to obtain the **net revenue** $NR = GR - rebated\ amount$,

which can be calculated as $NR = 12.91801 - \frac{2}{3} = 12.25134$.

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July 30, 2024

APPENDIX A: CURRICULUM VITAE

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1982–83	Visiting Professor, Yale University
	Professor, Department of Managerial Economics and Decision Sciences, Kellogg Graduate School of Management, Northwestern University
1981–82	Associate Professor, Department of Managerial Economics and Decision Sciences, Kellogg Graduate School of Management, Northwestern University
1979–81	Assistant Professor, Department of Managerial Economics and Decision Sciences, Kellogg Graduate School of Management, Northwestern University

Honors, Awards, Prizes, Fellowships, and Grants

2024	Honorary Doctorate, Charles University
2023	Distinguished Research Professor at Simons Laufer Mathematical Sciences Institute (supported by the Alfred P. Sloan Foundation)
2020	Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel
	Distinguished Fellow of the American Economics Association
2019	Robert Rosenthal Memorial Lecture (Boston University),
	Aumann Lecture (Israeli Game Theory Society),
	Marshall Lectures (Cambridge University)
2018	John J. Carty Award for the Advancement of Science, U.S. National Academy of Sciences
2017	CME Group-MSRI prize in Innovative Quantitative Applications, Chicago Mercantile Exchange and Mathematical Sciences Research Institute
	McKenzie lecture, University of Rochester
	Stanford Humanities and Sciences Dean's Award for Excellence in Graduate Education
	Elected Fellow of the Game Theory Society
	Elected Fellow of the Finance Theory Group
2016	Nancy Schwartz Memorial Lecture, Northwestern University

2015	National Science Foundation Award "Auction Market Design" Simon's Institute Public Lecture, University of California, Berkeley WINE (Web and Internet Economics) Keynote Lecture
2014	Golden Goose Award Keyfitz Lecture, Fields Institute, Toronto Arrow Lecture, Columbia University
2013	Nomura Lecturer, Institute of Mathematics, Oxford University BBVA Foundation Frontiers of Knowledge Award in Economics, Finance and Management
2012	Elected Vice President of the American Economic Association (term to begin in 2013) Inaugural lecture on "Incentive Auctions for Radio Spectrum," C.V. Starr Center Distinguished Speaker Series, New York University Oskar Morgenstern lecture on "Designing the US 'Incentive Auctions,'" Fourth World Congress of the Game Theory Society Becker Friedman Visitor, University of Chicago Intertic Stackelberg Lecture on "Auctions for Online Display Advertising"
2011	Eitan Berglas Lecture on "The Applied Science of Market Design," Tel Aviv University
2010	NSF-SBIR Phase IB Award for "Incorporating Bidder Budget Constraints in Multi-item Auctions"
2009	NSF-SBIR Phase I Award for "Incorporating Bidder Budget Constraints in Multi-Item Auctions" Nemmers Lecture, Northwestern University EARIE (European Association for Research in Industrial Organization) Lecture
2008	Erwin Plein Nemmers Prize W.A. Mackintosh Lecture, Queens University Simon Newcomb Lecture, Johns Hopkins University
2007	President, Western Economic Association International (WEAI) National Science Foundation Grant on "Market Design"

2006	Elected to the National Academy of Sciences Colin Clarke Lecture, Econometric Society Australasian Meeting Manchot Lecture, University of Bonn
2005	Elected to the Executive Committee of the Econometric Society Elected Vice President of the Western Economic Association Chung-Hua Lecturer, Academia Sinica (Taiwan) Clarendon Lecturer, Oxford University
2004	Fischer-Schulz Lecturer, Econometric Society Koopmans Lecturer, Yale University National Science Foundation Research Grant to study "Electronic Auction Markets" Council Member, Econometric Society
2003	National Science Foundation Research Grant to study "Cumulative Offer Processes" Landau Economics Teaching Prize, Stanford University Elected to the Council, Game Theory Society Distinguished Economist Lecture, Federal Communications Commission
2001	Honorary Doctorate, Stockholm School of Economics
2000	Taussig Visiting Research Professor, Harvard University
1999	Murray S. Johnson Inaugural Lecture, University of Texas Industry Canada Distinguished Lecture
1998	Fain Lecture, Brown University Lawrence Klein Lecture, University of Pennsylvania Fellow (2nd time), Center for Advanced Study in the Behavioral Sciences
1997	Alberto Bailleres Founder's Lecture at Instituto Tecnologico Autonomo de Mexico (ITAM) Plenary Lecturer, Econometric Society Far Eastern Meeting Plenary Lecturer, Australian Industry Economics Meeting, University of Melbourne
1996	Nobel Prize Memorial Lecture (honoring deceased Nobel laureate William Vickrey) at the Royal Swedish Academy of Sciences
1995	Churchill Lectures at Cambridge University Political Economy Special Lecture at Harvard University

1994	National Science Foundation Research Grant to study "Comparative Statics, Complementarities, Coordination and Change," (covering 1994 to 1997)
	Woytinsky Distinguished Lecturer, University of Michigan
1993	Senior Research Fellow, Institute for Policy Reform
	Shirley R. and Leonard W. Ely, Jr. Professor of Humanities and Sciences, Stanford University
1992	Fellow, American Academy of Arts and Sciences
	International Guest Scholar, Kyoto University
1991	Fellow, Center for Advanced Study in the Behavioral Sciences
	National Science Foundation Research Grant to study "Theories of the Firm 2" (covering 1991 to 1994)
1990	Center for Economic Policy Research Grant to study "The Economics of Modern Manufacturing"
1989	National Science Foundation Grant to direct programs for the Stanford Institute for Theoretical Economics
	National Academy of Sciences Award to lecture in China on economics of organizations
1988	Olin Distinguished Lecturer, Princeton University
	National Science Foundation Research Grant to study "Theories of the Firm" (covering 1988 to 1991)
	Center for Economic Policy Research Grant
1987	Prize for Best Paper of the Year in the Transactions of the Society of Actuaries
1986	Ford Visiting Professor of Economics, University of California, Berkeley
	John Simon Guggenheim Fellowship to study "Economic Theories of Organization"
1985	Williams Brothers Chair in Management Studies, Yale University
	National Science Foundation Research Grant to study "On the Formal Economic Theory of Organizations"
	Fellow of the Institute for Advanced Studies, Hebrew University of Jerusalem
	Plenary Lecturer at the Fifth World Congress of the Econometric Society

1984	Fellow of the Econometric Society
	Fellow of Morse College, Yale University
1983	Research Award, Actuarial Education and Research Fund
	Honorary Master of Arts degree, Yale University
1982	National Science Foundation Research Grant to study "The Structure of Information in a Productive Organization"
1981	IBM Research Chair at Northwestern University
	Visiting Research Associate, Stanford University
1980	Leonard J. Savage Memorial Thesis Award
	National Science Foundation Research Grant to study "Information and Uncertainty in Competitive Bidding"
1976	Society of Actuaries Triennial Paper Prize for best paper by an actuary within five of membership, for the period 1973–75
1974	Fellow of the Society of Actuaries

Publications

Articles

"Incentive Auction Design Alternatives: A Simulation Study," with Kevin Leyton-Brown, Neil Newman and Ilya Segal. *Management Science,* February 2024.

"Algorithmic Mechanism Design with Investment," with Mohammad Akbarpour, Scott Kominers, Kevin Michael Li, and Shengwu Li. *Econometrica,* November 2023.

"Taming the Communication and Computation Complexity of Combinatorial Auctions: The FUEL Bid Language," with Martin Bichler and Gregor Schwarz. *Management Science*, June 2022.

"When Should Control Be Shared?" with Eva Meyersson Milgrom and Ravi Singh, *Management Science*, March 2022.

"Auction Research Evolving: Theorems and Market Designs," *American Economic Review,* May 2021.

"Extended Proper Equilibrium," with Joshua Mollner, *Journal of Economic Theory*, June 2021.

"Clock Auctions and Radio Spectrum Reallocation," with Ilya Segal, *Journal of Political Economy*, January 2020.

"Auction Market Design: Recent Innovations," *Annual Reviews*, August 2019.

"Equilibrium Selection in Auctions and High Stakes Games," with Joshua Mollner, *Econometrica*, January 2018.

"Redesigning Spectrum Licenses," with Anthony Zhang and E. Glen Weyl, *Regulation*, Fall 2017.

"Economics and Computer Science of a Radio Spectrum Reallocation," with Kevin Leyton-Brown and Ilya Segal, *Proceedings of the National Academy of Sciences*, July 2017.

"Adverse Selection and Auction Design in Internet Display Advertising," with Nick Arnosti and Marissa Beck, *American Economic Review*, October 2016.

"Ascending Prices and Package Bidding: Further Experimental Analysis," with John Kagel and Yuanchuan Lien, *Games and Economic Behavior*, May 2014.

"Designing Random Allocation Mechanisms: Theory and Applications," with Eric Budish, Yeon-Koo Che and Fuhito Kojima, *American Economic Review*, April 2013.

"Critical Issues in Market Design," *Economic Inquiry*, April 2011.

"Simplified Mechanisms with an Application to Sponsored-Search Auctions," *Games and Economic Behavior*, September 2010.

"Ascending Prices and Package Bidding: A Theoretical and Experimental Analysis," with Yuanchuan Lien and John Kagel, *American Economic Journal: Microeconomics*, August 2010.

"Online Advertising: Heterogeneity and Conflation in Market Design," with Jon Levin, *American Economic Review*, May 2010.

"Assignment Messages and Exchanges," *American Economic Journal: Microeconomics*, August 2009. Reprinted in *Handbook of Spectrum Auction Design*, by Martin Bichler and Jacob Goeree (eds.), Cambridge University Press, 2017.

"The Limited Influence of Unemployment on the Wage Bargain," with Robert Hall, *American Economic Review*, September 2008. Reprinted in *Political Economy: Critical Concepts*, by Norman Schofield, Dino Falaschetti and Andrew Rutten (eds.), New York: Routledge, 2011.

"Substitute Goods, Auctions and Equilibrium," with Bruno Strulovici, Journal *of Economic Theory*, June 2008

“The Promise of Prediction Markets” (with 22 co-authors), *Science*, May 2008.

“What the Seller Won’t Tell You: Persuasion and Disclosure in Markets,” *Journal of Economics Perspectives*, Spring 2008.

“Core-Selecting Package Auctions,” with Bob Day, *International Journal of Game Theory*, March 2008. Reprinted in *Handbook of Spectrum Auction Design*, by Martin Bichler and Jacob Goeree (eds.), Cambridge University Press, 2017.

“Package Auctions and Package Exchanges” (2004 Fisher-Schultz lecture), *Econometrica*, July 2007.

“Matching with Contracts,” with John Hatfield, *American Economic Review*, September 2005.

“Ascending Auctions with Package Bidding,” with Lawrence M. Ausubel, *Frontiers of Theoretical Economics*, August 2002. Republished in *Advances in Theoretical Economics*, 2002.

“Package Bidding: Vickrey vs Ascending Auctions,” with Lawrence M. Ausubel, *Revue Economique*, May 2002.

“Envelope Theorems for Arbitrary Choice Sets,” with Ilya Segal, *Econometrica*, March 2002.

“Advances in Routing Technologies and Internet Peering Agreements,” with Stan Besen, Bridger Mitchell and Padmanabhan Srinagesh, *American Economic Association Papers and Proceedings*, May 2001.

“Putting Auction Theory to Work: The Simultaneous Ascending Auction,” *Journal of Political Economy*, April 2000. Reprinted in *Handbook of Spectrum Auction Design*, by Martin Bichler and Jacob Goeree (eds.), Cambridge University Press, 2017.

“Game Theory and the Spectrum Auctions,” *European Economic Review*, May 1998.

“Coalition-Proofness and Correlation with Arbitrary Communication Possibilities,” with John Roberts, *Games and Economic Behavior*, November 1996.

“The LeChatelier Principle,” with John Roberts, *American Economic Review*, March 1996. Reprinted in *Paul Anthony Samuelson, Critical Assessments of Contemporary Economists*, by John Cunningham Wood and Michael McLure (eds.), New York: Routledge, 2004.

“The Economics of Modern Manufacturing: Technology, Strategy and Organization: Reply,” *American Economic Review*, September 1995.

"Deterring Predation in Telecommunications: Are Line-of-Business Restraints Needed?" with Susan Gates and John Roberts, *Managerial and Decision Economics*, July 1995. Reprinted in *Deregulating Telecommunications: The Baby Bells' Case for Competition*, by R.S. Higgins and P.H. Rubin (eds). Chichester: John Wiley & Sons, 1995.

"Complementarities and Fit: Strategy, Structure and Organizational Change in Manufacturing," with John Roberts, *Journal of Accounting and Economics*, March 1995.

"The Firm as an Incentive System," with Bengt Holmstrom, *American Economic Review*, September 1994. Reprinted in *The Theory of the Firm: Critical Perspectives*, by Nicolai Juul Foss (ed.), New York: Routledge, 2000. Reprinted in *Readings in the Economics of the Division of Labor, Vol 2: Modern Analyses*, by Guang-Zhen Sun (ed.), World Scientific, 2005.

"Coordination, Commitment and Enforcement: The Case of the Merchant Guild," with Avner Greif and Barry Weingast, *Journal of Political Economy*, August 1994. Reprinted in *Explaining Social Institutions*, by Jack Knight and Itai Sened (eds.), Ann Arbor: University of Michigan Press, 1995. Reprinted in *Trust*, by Elias Khalil (ed.), London: Edward Elgar Publishing, 2002. Reprinted in *The Foundations Library of the New Institutional Economics*, by Claude Ménard (ed.), London: Edward Elgar Publishing, 2005. Reprinted in *Social Norms, Non-legal Sanctions, and the Law*, by Eric Posner (ed.), London: Edward Elgar Publishing, 2007. Reprinted in *Customary Law*, by Lisa Bernstein and Francesco Parisi (eds.), London: Edward Elgar Publishing, forthcoming.

"Comparing Equilibria," with John Roberts, *American Economic Review*, June 1994. Reprinted in *Equilibrium*, by Donald Walker (ed.), Edward Elgar Publishing, 2000.

"Comparing Optima: Do Simplifying Assumptions Affect Conclusions?" *Journal of Political Economy*, June 1994.

"Complementarities and Systems: Understanding Japanese Economic Organization," with John Roberts, *Estudios Economicos*, April 1994.

"Monotone Comparative Statics," with Chris Shannon, *Econometrica*, January 1994.

"Organizational Prospects, Influence Costs and Ownership Changes," with Margaret Meyer and John Roberts, *Journal of Economics and Management Strategy*, Spring 1992.

"Pay, Perks and Parachutes: Do They Pay?" with John Roberts, *Stanford Business*, 1992.

"Information and Timing in Repeated Partnerships," with Dilip Abreu and David Pearce, *Econometrica*, November 1991.

"A Theory of Hierarchies Based on Limited Managerial Attention," with John Geanakoplos, *Journal of Japanese and International Economies*, September 1991. Reprinted in *The Economics of Organization and Bureaucracy*, by Peter Jackson (ed.), London: Edward Elgar Publishing, 2013.

"Complementarities, Momentum, and the Evolution of Modern Manufacturing," with Yingyi Qian and John Roberts, *American Economic Association Papers and Proceedings*, May 1991.

"Multitask Principal-Agent Analyses: Incentive Contracts, Asset Ownership and Job Design," with Bengt Holmstrom, *Journal of Law, Economics and Organization*, Spring 1991. Reprinted in *Transaction Cost Economics*, by Oliver Williamson and Scott Masten (eds.), London: Edward Elgar Publishing, 1994. Reprinted in *The Principal-Agent Model: The Economic Theory of Incentives*, by J-J Laffont (ed.), Cheltenham: Edward Elgar Press, 2003. Reprinted in *The International Library of the New Institutional Economics*, by Claude Ménard (ed.), London: Edward Elgar Publishing, 2005. Reprinted in *The Economic Nature of the Firm*, by Louis Putterman and Randall Kroszner (ed.), Cambridge University Press, 1996. Reprinted in *The Economics of Contracts*, by Patrick Bolton, Barbara and David Zalaznick (eds.), Cheltenham: Edward Elgar Press, 2008. Reprinted in *Institutional Law and Economics*, by Pablo Spiller (ed.), Cheltenham: Edward Elgar Press, forthcoming.

"Adaptive and Sophisticated Learning in Repeated Normal Form Games," with John Roberts, *Games and Economic Behavior*, February 1991. Reprinted in *Recent Developments in Game Theory*, by E. Maskin (ed.), Cheltenham: Edward Elgar, 1998.

"Rationalizability, Learning and Equilibrium in Games with Strategic Complementarities," with John Roberts, *Econometrica*, November 1990. Reprinted in *Recent Developments in Game Theory*, by E. Maskin (ed.), Cheltenham: Edward Elgar, 1998.

"The Economics of Modern Manufacturing: Technology, Strategy and Organization," with John Roberts, *American Economic Review*, June 1990. Reprinted in *Vestnik St. Petersburgskogo Universiteta, Economics Seria* (the Journal of the Economics Faculty of St. Petersburg University), 1993 (in translation). Reprinted in *Economics of the Firm: Lessons in Business Organization*, by Andrei Demin and Valery Katkalo (eds.), St. Petersburg, Russia: 1994. Reprinted in *The Economics of Communications and Information*, by Donald Lamberton (ed.), Cheltenham: Edgar Elgar Publishing, 1996. Reprinted in *Readings in Applied Microeconomic Theory: Market Forces and Solutions*, by Robert E. Kuenne (ed.), Blackwell Publishers, 2000. Reprinted in *Fundamentals of Business Strategy*, by Mie Augur and David Teece (eds.), Sage Publications, 2007.

"Short Term Contracts and Long Term Agency Relationships," with Drew Fudenberg and Bengt Holmstrom, *Journal of Economic Theory*, June 1990.

"The Efficiency of Equity in Organizational Decision Processes," with John Roberts, *American Economic Review Papers and Proceedings*, May 1990.

"The Role of Institutions in the Revival of Trade: The Medieval Law Merchant," with Douglass North and Barry Weingast, *Economics and Politics*, March 1990. Reprinted in *Trade in the Pre-Modern Period: 1400-1700*, by Douglas Irwin (ed.), London: Edward Elgar Publishing, 1996. Reprinted in *Reputation: Studies in the Voluntary Elicitation of Good Conduct*, by Daniel B. Klein (ed.), Ann Arbor, University of Michigan Press, 1997. Reprinted in *The Political Economy of Institutions*, by Claude Ménard (ed.), London: Edward Elgar Publishing, 2004. Reprinted in *International Institutions in the New Global Economy*, by Lisa L. Martin (ed.), London: Edward Elgar Publishing, 2005. Reprinted in *Anarchy and the Law*, by Edward Stringham (ed.), New Brunswick, New Jersey: Transaction Publishers, 2006. Reprinted in *Social Norms, Non-Legal Sanctions, and the Law*, by Eric A. Posner (ed.), London: Edward Elgar Publishing, 2007.

"Regulating Trade Among Agents," with Bengt Holmstrom, *Journal of Institutional and Theoretical Economics*, March 1990. Reprinted in *The New Institutional Economics*, by Erik G. Furubotn and Rudolph Richter (eds.), College Station: Texas A&M University Press, 1991.

"Auctions and Bidding: A Primer," *Journal of Economic Perspectives*, Summer 1989. Reprinted in *Readings in Microeconomic Theory*, by Manfredi La Manna (ed.), London: Dryden Press, 1997.

"Communication and Inventories as Substitutes in Organizing Production," with John Roberts, *Scandinavian Journal of Economics*, September 1988.

“Economic Theories of Organization: Past, Present and Future,” with John Roberts, *Canadian Journal of Economics*, August 1988. Reprinted in *The Economics of Contracts and Industrial Organization: A Reader*, Peter Buckley and Jonathan Michie (eds.), Oxford University Press, 1996.

“An Economic Approach to Influence Activities and Organizational Responses,” with John Roberts, *American Journal of Sociology*, July 1988.

“Employment Contracts, Influence Activities and Efficient Organization Design,” *Journal of Political Economy*, February 1988.

“Job Discrimination, Market Forces, and the Invisibility Hypothesis,” with Sharon Oster, *Quarterly Journal of Economics*, August 1987. Reprinted in *Learning in Labour Markets*, by Michael Waldman (ed.), Cheltenham: Edward Elgar Press.

“Informational Asymmetries, Strategic Behavior and Industrial Organization,” with John Roberts, *American Economic Association Papers and Proceedings*, May 1987.

“Aggregation and Linearity in the Provision of Intertemporal Incentives,” with Bengt Holmstrom, *Econometrica*, March 1987. Reprinted in *The Principal-Agent Model: The Economic Theory of Incentives*, by J-J Laffont (ed.), Cheltenham: Edward Elgar Press. Reprinted in *The Economics of Contracts*, by Patrick Bolton, Barbara and David Zalaznick (eds.), Cheltenham: Edward Elgar Press.

“Price and Advertising Signals of Product Quality,” with John Roberts, *Journal of Political Economy*, August 1986. Reprinted in *Antitrust and Competition*, by Andrew Kleit (ed.), Cheltenham: Edward Elgar Publishing, 2005. Reprinted in *The Economics of Marketing, Martin Carter*, by Mark Casson and Vivek Suneja (eds.), Cheltenham: Edgar Elgar Publishing, 1998. Reprinted in *Readings in Industrial Organization*, by Luis M.B. Cabral (ed.), Oxford: Blackwell Publishers, 2000.

“Relying on the Information of Interested Parties,” with John Roberts, *Rand Journal of Economics*, April 1986. Reprinted in *Economics of Evidence, Procedure and Litigation*, by Chris William Sanchirico (ed.), Cheltenham: Edward Elgar Publishing, 2007.

“Distributional Strategies for Games with Incomplete Information,” with Robert Weber, *Mathematics of Operations Research*, November 1985.

“Bid, Ask and Transactions Prices in a Specialist Market with Heterogeneously Informed Traders,” with Lawrence R. Glosten, *Journal of Financial Economics*, March 1985.

"Reply to the Comments on 'Measuring the Interest Rate Risk,'" *Transactions of the Society of Actuaries, XXXVII*, 1985

"Measuring the Interest-Rate Risk," *Transactions of the Society of Actuaries, XXXVII*, 1985.

"Competitive Bidding with Proprietary Information," with Richard Engelbrecht-Wiggans and Robert Weber, *Journal of Mathematical Economics*, April 1983.

"A Theory of Auctions and Competitive Bidding," with Robert Weber, *Econometrica*, September 1982. Reprinted in *Game Theory in Economics*, by Ariel Rubinstein (ed.), London: Edward Elgar Publishing, 1990. Reprinted in *The Economics of Information*, by Steven A. Lippman and John E. Anderson (eds.), London: Edward Elgar Publishing, 1994. Reprinted in *The Economic Theory of Auctions*, by Paul Klemperer (ed.), London: Edward Elgar Publishing, 1999. Reprinted in *Readings in Applied Microeconomic Theory: Market Forces and Solutions*, by Robert E. Kuenne (ed.), Blackwell Publishers, 2000.

"Predation, Reputation, and Entry Deterrence," with John Roberts, *Journal of Economic Theory*, August 1982. Reprinted in *Antitrust and Competition*, by Andrew Kleit (ed.), Cheltenham: Edward Elgar Publishing, 2005. Reprinted in *The Economics of Reputation*, by Jill J. McCluskey and Jason Winfree (eds.), Edward Elgar Publishing, 2017.

"Rational Cooperation in the Finitely-Repeated Prisoners' Dilemma," with David Kreps, John Roberts and Robert Wilson, *Journal of Economic Theory*, August 1982. Reprinted in *Game Theory in Economics*, by Ariel Rubinstein (ed.), Cheltenham: Edward Elgar Publishing, 1990. Reprinted in *Trust*, by Elias L. Khalil (ed.), Cheltenham: Edward Elgar Publishing, 2003.

"The Value of Information in a Sealed Bid Auction," with Robert Weber, *Journal of Mathematical Economics*, June 1982. Reprinted in *The Economic Theory of Auctions*, by Paul Klemperer (ed.), London: Edward Elgar Publishing, 1999.

"Limit Pricing and Entry Under Incomplete Information: An Equilibrium Analysis," with John Roberts, *Econometrica*, March 1982. Reprinted in *Industrial Organization*, by Oliver Williamson (ed.), London: Edward Elgar Publishing, 1990. Reprinted in *The Economics of Information*, by Steven A. Lippman and John E. Anderson (eds.), London: Edward Elgar Publishing, 1994. Reprinted in *Readings in Industrial Organization*, edited by Luis M.B. Cabral (ed.), Oxford: Blackwell Publishers, 2000. Reprinted in *Pricing*, by Michael Waldman and Justin P. Johnson (ed.), London: Edward Elgar Publishing, 2007.

"Information, Trade and Common Knowledge," with Nancy Stokey, *Journal of Economic Theory*, February 1982.

"Good News and Bad News: Representation Theorems and Applications," *Bell Journal of Economics*, October 1981.

"Rational Expectations, Information Acquisition, and Competitive Bidding," *Econometrica*, July 1981. Reprinted in *The Economic Theory of Auctions*, by Paul Klemperer (ed.), London: Edward Elgar Publishing, 1999.

"An Axiomatic Characterization of Common Knowledge," *Econometrica*, January 1981.

"A Convergence Theorem for Competitive Bidding with Differential Information," *Econometrica*, May 1979.

"On Understanding the Effects of GAAP Reserve Assumptions," *Transactions of the Society of Actuaries, XXVII*, 1975.

Books

Discovering Prices: Auction Design in Markets with Complex Constraints. Columbia University Press, 2017.

Putting Auction Theory to Work. Cambridge: Cambridge University Press, 2004.

Contributions to Books and Proceedings

"Spectrum Auctions from the Perspective of Matching," with Andrew Vogt, *Online and Matching-Based Market Design*, Cambridge University Press, 2023.

"How Artificial Intelligence and Machine Learning Can Impact Market Design," with Steve Tadelis, *The Economics of Artificial Intelligence: An Agenda*, edited by Ajay K. Agrawal, Joshua Gans, and Avi Goldfarb, 2019.

"Winning Play in Spectrum Auctions," with Jeremy Bulow and Jonathan Levin, in *Handbook of Spectrum Auction Design*, by Martin Bichler and Jacob Goeree (eds.), Cambridge University Press, 2017.

"Designing the US Incentive Auction," in *Handbook of Spectrum Auction Design*, by Martin Bichler and Jacob Goeree (eds.), Cambridge University Press, 2017.

"Optimal Incentives in Core-Selecting Auctions," with Bob Day, in *The Handbook of Market Design*, by Zvika Neeman, Al Roth, and Nir Vulkan (eds.), Oxford University Press, 2013.

"Incentive Auction: Rules and Discussion," with Lawrence Ausubel, Jonathan Levin and Ilya Segal, published as Appendix C of the FCC 12-118 (Notice of Proposed Rulemaking on the Incentive Auction, Released October 2, 2012).

"Complementarity in Organizations," with Erik Brynjolfsson, in *The Handbook of Organizational Economics*, by John Roberts and Bob Gibbons (eds.), Princeton University Press, 2012.

"Multipliers and the LeChatelier Principle," in *Samuelsonian Economics and the Twenty-First Century*, by Michael Szenberg, Lall Ramrattan and Aron Gottesman (eds.), Oxford University Press, 2006.

"The Clock-Proxy Auction: A Practical Combinatorial Design," with Lawrence M. Ausubel and Peter Cramton, in *Combinatorial Auctions*, by Peter Cramton, Richard Steinberg and Yoav Shoham (eds.), MIT Press, 2005. Reprinted in *Handbook of Spectrum Auction Design*, by Martin Bichler and Jacob Goeree (eds.), Cambridge University Press, 2017.

"Ascending Proxy Auctions," with Lawrence M. Ausubel, in *Combinatorial Auctions*, by Peter Cramton, Richard Steinberg and Yoav Shoham (eds.), MIT Press, 2005.

"The Lovely but Lonely Vickrey Auction," with Lawrence M. Ausubel, in *Combinatorial Auctions*, by Peter Cramton, Richard Steinberg and Yoav Shoham (eds.), MIT Press, 2005.

"Competitive Effects of Internet Peering Policies," with Bridger Mitchell and Padmanabhan Srinagesh, in *The Internet Upheaval*, by Ingo Vogelsang and Benjamin Compaine (eds.), Cambridge: MIT Press, 2000.

"A Theory of Auctions and Competitive Bidding, II," with Robert Weber, in *The Economic Theory of Auctions*, by Paul Klemperer (ed.), Edward Elgar Publishing, 1999.

"Combination Bidding in Spectrum Auctions," in *Competition, Regulation and Convergence: Current Trends in Telecommunications Research*, by Sharon Gillett and Ingo Vogelsang (eds.), New Jersey: Lawrence Erlbaum Associates, Publishers, 1999.

"The Internal Politics of the Firm," with John Roberts, in *The Politics of Exchange and the Economics of Power*, by Samuel Bowles, Maurizio Franzini and Ugo Pagano (eds.), New York: Routledge, 1998.

"Procuring Universal Service: Putting Auction Theory to Work," in *Le Prix Nobel: The Nobel Prizes, 1996*, Nobel Foundation, 1997.

"Procuring Universal Telephone Service," in *1997 Industry Economics Conference, Industry Commission (ed.), Conference Proceedings*, 1997, AGPS.

"Complementarities in the Transition from Socialism: A Firm-Level Analysis," with Susan Gates and John Roberts, in *Reforming Asian Socialism: The Growth of Market Institutions*, by John McMillan and Barry Naughton (eds.), Ann Arbor: University of Michigan Press, 1996.

"Continuous Adjustment and Fundamental Change in Business Strategy and Organization," with John Roberts, in *Trends in Business Organization: Do Participation and Cooperation Increase Competitiveness?*, by Horst Siebert (ed.), Tübingen: J.C.B. Mohr (Paul Siebeck), 1995.

"Johnson Controls, Inc—Automotive Systems Group: The Georgetown Kentucky Plant," with John Roberts, *Case #S-BE-9, Stanford Graduate School of Business*, November 1993.

"Is Sympathy an Economic Value? Philosophy, Economics and the Contingent Valuation Method," in *Contingent Valuation: A Critical Assessment*, by Jerry Hausman (ed.), Elsevier-North Holland, 1993.

"The Real Output of the Stock Exchange," with Timothy F. Bresnahan and Jonathan Paul, in *Output Measurement in the Services Sectors*, by Zvi Griliches (ed.), 1992.

"Bargaining Costs, Influence Costs and the Organization of Economic Activity," with John Roberts, in *Perspectives on Positive Political Economy*, by James E. Alt and Kenneth A. Shepsle (eds.), Cambridge: Cambridge University Press, 1990. Reprinted in *Transaction Cost Economics*, by Oliver Williamson and Scott Masten (eds.), London: Edward Elgar Publishing Co., 1994. Reprinted in *The International Library of the New Institutional Economics*, by Claude Ménard (ed.), London: Edward Elgar Publishing, 2003. Reprinted in *The Economic Nature of the Firm*, by Louis Putterman and Randall Kroszner (eds.), Cambridge University Press, 1996. Reprinted in *The International Library of the New Institutional Economics*, by Claude Ménard (ed.), London: Edward Elgar Publishing, 2005.

"New Theories of Predatory Pricing," with John Roberts, *Industrial Structure in the New Industrial Economics*, by Giacomo Bonanno and Dario Brandolini (eds.), Oxford: Oxford University Press, 1990.

"An Essay on Price Discrimination," in *The Economics of Imperfect Competition and Employment: Joan Robinson and Beyond*, by George Feiwel (ed.), New York: MacMillan and New York: New York University Press, 1989.

"Predatory Pricing," in *The New Palgrave: A Dictionary of Economic Theory and Doctrine*, by J. Eatwell, M. Milgate, and P. Newman (eds.), London: MacMillan Press Ltd., 1988.

"Auction Theory," in *Advances in Economic Theory: Fifth World Congress*, by Truman Bewley (ed.), London: Cambridge University Press, 1987.

"The Economics of Competitive Bidding: A Selective Survey," in *Social Goals and Social Organization: A Volume in Honor of Elisha Pazner*, by L. Hurwicz, D. Schmeidler and H. Sonnenschein (eds.), London: Cambridge University Press, 1985.

"Private Information in an Auction-Like Securities Market," in *Auctions, Bidding and Contracting: Uses and Theory*, by R. Engelbrecht-Wiggans, M. Shubik and R. Stark (eds.), New York: New York University Press, New York, 1983.

"Topologies on Information and Strategies in Normal-Form Games with Incomplete Information," with Robert Weber, in *Game Theory and Mathematical Economics*, by O. Moeschlin and D. Pallaschke (eds.), New York: North Holland, 1981.

Patents

Paul Milgrom, Stephan Cunningham, Marissa Beck. "United States Patent 11,574,358 Impression Allocation System and Method Using an Auction that Considers Losing Bids," OpenX Technologies, Inc, Feb 7, 2023

Paul Milgrom, Steve Goldband. "United States Patent 8,788,364 System for Configuration and Implementation of an Assignment Auction or Exchange," Auctionomics, Inc, Jul 22, 2014

Lawrence Ausubel, Peter Cramton, Paul Milgrom. "United States Patent 8,744,924 System and Method for Efficient Clearing of Spectrum Encumbrances," Efficient Auctions, LLC, Jun 3, 2014

Marc Porat, Kevin Surace, Paul Milgrom. "United States Patent 8,738,463 Method, System and Business Model for a Buyer's Auction with Near-Perfect Information Using the Internet," Perfect Commerce, LLC, May 27, 2014

Paul Milgrom, David Salant. "United States Patent 8,577,746 System and Method for a Multi-Product Clock Auction," Auction Technologies, LLC, Nov 5, 2013

Lawrence Ausubel, Paul Milgrom. "United States Patent 8,566,211 System and Method for a Dynamic Auction with Package Bidding," Efficient Auctions, LLC, Oct 22, 2013

Marc Porat, Kevin Surace, Paul Milgrom. "United States Patent 8,341,033 Method, System and Business Model for a Buyer's Auction with Near-Perfect Information Using the Internet," Perfect Commerce, Dec 25, 2012

Lawrence Ausubel, Peter Cramton, Paul Milgrom. "United States Patent 8,335,738 System and Method for a Hybrid Clock and Proxy Auction," Efficient Auctions, LLC, Dec 18, 2012

Paul Milgrom, Steven Goldband. "United States Patent 8,271,345 System and Method for Incorporating Bidder Budgets in Multi-Item Auctions," Auctionomics, Inc, Sep 18, 2012

Lawrence Ausubel, Peter Cramton, Paul Milgrom. "United States Patent 8,224,743 System and Method for a Hybrid Clock and Proxy Auction," Efficient Auctions, LLC, Jul 17, 2012

Others

"The Market Design Community and the Broadcast Incentive Auction: Fact-Checking Glen Weyl's and Stefano Feltri's False Claims," Digitopoly, June 2020.

"Commentary on Effective Allocation of Affordable Housing by Nick Arnosti and Peng Shi" with Mitchell Watt, Management Science Blog, May 2020.

"How Obscure Science Led to Spectrum Auctions That Connected the World," April 2017.

"Ad Exchanges Are Not All The Same: How Better Policed Exchanges Help Premium Publishers," OpenX, 2015.

"The Case for Unlicensed Spectrum," with Jonathan Levin, October 2011.

"Making Carbon Markets Work," SIEPR, May 2009.

"Using Procurement Auctions to Allocate Broadband Stimulus Grants," SIEPR, May 2009.

"The Promise of Prediction Markets," with multiple co-authors, May 2008.

"Economists' Statement on US Broadband Policy," with multiple co-authors, March 2006.

"Promoting Efficient Use of Spectrum Through Elimination of Barriers to Secondary Markets," with multiple co-authors, February 2001.

"An Economist's Vision of the B-to-B Marketplace," Palo Alto: Perfect, 2000.

Working Papers

"Kenneth Arrow's Last Theorem," May 2024.

"Walrasian Mechanisms for Non-Convex Economies and the Bound-Form First Welfare Theorem," with Mitchell Watt, July 2022.

"Fuel for 5g," Auctionomics White Paper, June, 2019.

"The CAF Auction: Design Proposal," with Assaf Eilat, July 2011.

"Adverse Selection without Hidden Information," June 1987.

Major Professional Activities and Affiliations

2017-21	Chair, Economics section (54) of the National Academy of Sciences
2020	SIGecom Test of Time Award Committee
2019-20	CME-MSRI Award Committee
2016–17	National Academy of Sciences: Class Membership Committee Chair, NAS Temporary Nominating Group
2016	National Academy of Sciences: Air Force Studies Board Committee
2015–present	Editorial Board, Proceedings of the National Academy of Sciences Executive Supervisory Committee, CERGE-EI National Academies' Intelligence Science and Technology Experts Group (ISTEG)
2012–17	Lead consultant to Federal Communications Commission Incentive Auctions Task Force
2012–14	Editorial Board of European Journal of Pure and Applied Mathematics
2009–present	Editorial Board of AEJ-Microeconomics
2007–08	President, Western Economic Association International (WEAI)
2006–07	Member, National Academy of Sciences President-Elect, Western Economic Association International (WEAI)
2005–06	Vice President, Western Economic Association International (WEAI)
2005–08	Executive Committee of the Econometric Society
2004–06	Council, Econometric Society
2003–present	Council, Game Theory Society

2000–02	Chief economist, Perfect Commerce
1997–02	Editorial Consultant, MIT Press
1997–99	Editorial Board, Journal of Comparative Economics
1996–16	Founder and Director, Market Design Inc. (Chairman, 1996–02)
1996	Nemmers Prize Selection Committee, Northwestern University
1996–06	Advisory Board, Microeconomics Abstracts
1995–05	Advisory Board, Economics Research Network
1994–95	Program Committee, 1995 World Congress of the Econometric Society
1993–95	Senior Research Fellow, Institute for Policy Reform
1993–00	Associate Editor, American Economic Review
1992–present	Fellow, American Academy of Arts and Sciences
1990–93	Co-Editor, American Economic Review
1990–present	Associate Editor, Games and Economic Behavior
1989–92	Associate Editor, Journal of Financial Intermediation
1987–90	Associate Editor, Econometrica
1985–89	Associate Editor, Rand Journal of Economics
1983–87	Associate Editor, Journal of Economic Theory
1984	Chair, Program Committee, Econometric Society Winter Meetings
1984–present	Fellow, Econometric Society
1980–present	Member, American Economic Association

Expert Reports and Testimony (2000–present)

1. Public Utility Commission of Oregon, in the matter of the Application of Portland General Electric for Approval of the Customer Choice Plan, Docket UE 102.

2. American Arbitration Association, in the matter of MCG PCS v Leap Wireless International. (February 2002)

3. American Arbitration Association, in the matter of Guilherme Augusto Frering and Mario Augusto Frering v Mitsui and Co., Ltd., and Cayman Iron Ore Investment Co., Ltd. (July 2003)

4. United States of America Ex Rel. R.C. Taylor III, v Mario Gabelli, Lynch Corp., Lynch Interactive Corp., Lynch PCS Communications Corp. et al. Case No. 03 Civ. 8762 (SAS)(GWG), Southern District of New York. (March 2006)

5. Bid For Position v. Google et al, Case No 2:07-cv- 582 (JBF/TEM), Eastern District of Virginia, Norfolk Division.

6. Marla Tidenberg v. BidZ, Inc, United States District Court, Central District of California, Case No. CV08-05553 PSG (FMOx). (January 2010).

7. Alaska Electrical Pension Fund, et al. v. Bank of America Corp., et al, Civil Action No. 14-cv-7126 (JMF). (January 2018)

8. Rick Woods v. Google LLC, Case 5:11-cv-01263-EJD. United States District Court, Northern District of California, San Jose Division.

9. United States, et al. v. Google LLC, Case 1:23-cv-0108 (LMB/JFA), United States District Court for the Eastern District of Virginia (January 2024).

APPENDIX B: LIST OF MATERIAL RELIED ON

A. *Complaint and Expert Reports*

State of Texas et al. v. Google LLC, Fourth Amended Complaint (May 5, 2023).
Expert Report of J. Andrien (Jun. 7, 2024).
Expert Report of J. Chandler (Jun. 7, 2024).
Expert Report of J. Gans (Jun. 7, 2024).
Expert Report of J. Hochstetler (Jun. 7, 2024).
Expert Report of P. Pathak (Jun. 7, 2024).
Expert Report of M. Weinberg (Jun. 7, 2024).

B. *Deposition Transcripts*

[redacted]
Deposition of J. Giles (Nov. 6, 2020), GOOG-AT-MDL-007172126.
[redacted]
Deposition of N. Jayaram (Sep. 17, 2021), GOOG-AT-MDL-007173084.
[redacted]
Deposition of T. Lipus (Apr. 3, 2024).
[redacted]
Deposition of B. Rowley (Jul. 22, 2021), GOOG-AT-MDL-007177040.
[redacted]
Deposition of S. Spencer (Aug. 12, 2021), GOOG-AT-MDL-007178292.

C. *Produced Google Documents*

1. *Data and Supporting Material*

GOOG-AT-DOJ-DATA-000066771 to GOOG-AT-DOJ-DATA-000066772.
GOOG-AT-EDTX-DATA-000000000 to GOOG-AT-EDTX-DATA-000258388.
GOOG-AT-EDTX-DATA-000276098 to GOOG-AT-EDTX-DATA-001116097.
GOOG-AT-EDTX-DATA-001116098.
GOOG-AT-EDVA-DATA-000000006.
GOOG-AT-MDL-DATA-000486626 to GOOG-AT-MDL-DATA-000488277.
GOOG-AT-MDL-DATA-000561263 to GOOG-AT-MDL-DATA-000561420.
Letter from D. Pearl to B. Nakamura and M. Freeman (Dec. 7, 2023), GOOG-AT-MDL-C-000012885.
Letter from D. Pearl to K. Garcia (Oct. 6, 2023), GOOG-AT-MDL-C-000012826.

Letter from D. Pearl to M. Freeman (Jun. 9, 2023), GOOG-AT-MDL-C-000012751.
Letter from D. Pearl to M. Freeman (Sep. 8, 2023), GOOG-AT-MDL-C-000012795.
Letter from J. Elmer to J. Hogan (Mar. 31, 2022), GOOG-AT-MDL-007334120.
Letter from J. Elmer to J. Hogan (Aug. 19, 2022), GOOG-AT-MDL-007334131.

2. Other Documents

GOOG-AT-MDL-001094067
GOOG-AT-MDL-001397473
GOOG-AT-MDL-002293467
GOOG-AT-MDL-003465605
GOOG-AT-MDL-003995286
GOOG-AT-MDL-004016180
GOOG-AT-MDL-004242638
GOOG-AT-MDL-004555239
GOOG-AT-MDL-006196134
GOOG-AT-MDL-007334120
GOOG-AT-MDL-007374059
GOOG-AT-MDL-007375273
GOOG-AT-MDL-008842383
GOOG-AT-MDL-008842393
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GOOG-AT-MDL-008935836
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GOOG-AT-MDL-009644409
GOOG-AT-MDL-010338120
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GOOG-DOJ-13199952
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GOOG-DOJ-13200480
GOOG-DOJ-13201465
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GOOG-DOJ-AT-02471119
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GOOG-DOJ-AT-02512863
GOOG-DOJ-AT-02524665
GOOG-NE-04599495
GOOG-TEX-00000001
GOOG-TEX-00048091
GOOG-TEX-00054839
GOOG-TEX-00090969
GOOG-TEX-00458239
GOOG-TEX-00537828
GOOG-TEX-00682264
GOOG-TEX-00782851
GOOG-TEX-00831373

D. *Produced Third-Party Documents*

[redacted]

[redacted]

E. Publicly Available Sources

1. Publications

Akbarpour, M., & Li, S. (2020). Credible auctions: A trilemma. *Econometrica*, *88*(2), 425-467.

Ausubel, L. M., & Milgrom, P. R. (2006). The lovely but lonely Vickrey auction. In *Combinatorial Auctions* (P. Cramton, Y. Shoham, & R. Steinberg, Eds.), *MIT Press*.

Balseiro, S. R., & Gur, Y. (2019). Learning in repeated auctions with budgets: Regret minimization and equilibrium. *Management Science*, *65*(9), 3952-3968.

Balseiro, S R.., Kim, A., Mahdian, M., & Mirrokni, V. (2017). Budget management strategies in repeated auctions. In *Proceedings of the 26th International Conference on World Wide Web*, 15-23.

Barlow, R. E., & Proschan, F. (1975). *Statistical theory of reliability and life testing: probability models* (Vol. 1). New York: Holt, Rinehart and Winston.

Bergemann, D., Brooks, B., and Morris, S. (2015). The limits of price discrimination. *American Economic Review*, *105*(3), 921-57.

Bergemann, D., & Välimäki, J. (2019). Dynamic mechanism design: An introduction. *Journal of Economic Literature*, *57*(2), 235-274.

Cai, Y., Daskalakis, C., & Weinberg, S. M. (2013). Understanding incentives: Mechanism design becomes algorithm design. In *2013 IEEE 54th Annual Symposium on Foundations of Computer Science*, 618-627.

Choi, A. H. (2009). A Rent Extraction Theory of Right of First Refusal. *The Journal of Industrial Economics*, *57*(2), 252–264.

Choi, H., & Mela, C. F. (2023). Optimizing reserve prices in display advertising auctions. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4523022.

Choi, H., Mela, C. F., Balseiro, S. R., & Leary, A. (2020). Online display advertising markets: A literature review and future directions. *Information Systems Research*, *31*(2), 556-575.

D'Annunzio, A., & Russo, A. (2024). Intermediaries in the online advertising market. *Marketing Science*, *43*(1), 33-53.

Despotakis, S., Ravi, R., & Sayedi, A. (2021). First-price auctions in online display advertising. *Journal of Marketing Research*, *58*(5), 888-907.

Doraszelski, U., Lewis, G., & Pakes, A. (2018). Just starting out: Learning and equilibrium in a new market. *American Economic Review*, *108*(3), 565-615.

Freixas, X., Guesnerie, R., & Tirole, J. (1985). Planning under incomplete information and the ratchet effect. *The Review of Economic Studies*, *52*(2), 173-91.

Fudenberg, D., & Tirole, J. (1991). *Game theory.* MIT Press.

Gans, J.S., & Holden, R. T. (2022). Mechanism design approaches to blockchain consensus, (NBER Working Paper No. w30189). National Bureau of Economic Research.

Goke, S., Weintraub, G. Y., Mastromonaco, R., & Seljan, S. (2022). Bidders' responses to auction format change in internet display advertising auctions. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4021221.

Guerre, E., Perrigne, I., & Vuong, Q. (2000). Optimal nonparametric estimation of first‐price auctions. *Econometrica*, *68*(3), 525-574.

Gui, G., Nair, H., & Niu, F. (2021). Auction throttling and causal inference of online advertising effects. arXiv preprint arXiv:2112.1515.

Harsanyi, J.C. (1967). Games with incomplete information played by Bayesian players, I-III. Part I. The basic model. *Management Science*, *14*(3), 159-182.

Heymann, B. (2020). How to bid in unified second-price auctions when requests are duplicated. *Operations Research Letters*, *48*(4), 446-451.

Hortaçsu, A., Luco, F., Puller, S. L., & Zhu, D. (2019). Does strategic ability affect efficiency? Evidence from electricity markets. *American Economic Review*, *109*(12), 4302-4342.

Hortaçsu, A., & Puller, S. L. (2008). Understanding strategic bidding in multi‐unit auctions: A case study of the Texas electricity spot market. *The RAND Journal of Economics*, *39*(1), 86-114.

Kahan, M., Leshem, S., & Sundaram, R. K. (2012). First-Purchase Rights: Rights of First Refusal and Rights of First Offer. *American Law and Economics Review*, *14*(2), 331–371.

Kaplan, T. R., & Zamir, S. (2012). Asymmetric first-price auctions with uniform distributions: analytic solutions to the general case. *Economitc Theory*, *50*(2), 269-302.

Klemperer, P. (1999). Auction theory: A guide to the literature. *Journal of Economic Surveys*, *13*(3), 227-86.

Kojima, F., & Pathak, P.A. (2009). Incentives and stability in large two-sided matching markets. *American Economic Review*, *99*(3), 608-627.

Krishna, V. (2010). *Auction theory* (2nd ed.). Academic Press.

Levin, J., & Milgrom, P. (2010). Online advertising: Heterogeneity and conflation in market design. *American Economic Review: Papers & Proceedings*, *100*(2), 603-07.

Mas-Colell, A., Whinston, M. D., & Green, J. R. (1995). *Microeconomic theory.* Oxford University Press.

McAfee, R. P., & McMillan, J. (1987). Auctions and bidding. *Journal of Economic Literature*, *25*(2), 699-738.

Milgrom, P. R. (2017). *Discovering prices: auction design in markets with complex constraints.* Columbia University Press.

Milgrom, P. R. (2004). *Putting auction theory to work*. Cambridge University Press.

Milgrom, P. R., & Segal, I. (2020). Clock auctions and radio spectrum reallocation. *Journal of Political Economy*, *128*(1), 1-31.

Milgrom, P. R., and Segal, I. (2002). Envelope theorems for arbitrary choice sets. *Econometrica*, *70*(2), 583-601.

Milgrom, P. R., & Shannon, C. (1994). Monotone comparative statics. *Econometrica*, *62*(1), 157-180.

Myerson, R. B. (1981). Optimal auction design. *Mathematics of Operations Research*, *6*(1), 58-73.

Ostrom, E. (2008). Tragedy of the commons. In *The New Palgrave Dictionary of Economics* (2nd ed.) (S. N. Durlauf & L. E. Blume, Eds.). Palgrave Macmillan.

Ostrovsky, M., & Schwarz, M. (2023). Reserve prices in internet advertising auctions: A field experiment. *Journal of Political Economy*, *131*(12), 3352-3376.

Pachilakis, M., Papadopoulos, P., Markatos, E. P., & Kourtellis, N. (2019). No more chasing waterfalls: a measurement study of the header bidding ad-ecosystem. In *Proceedings of the Internet Measurement Conference*, 280-293.

Perrigne, I., & Vuong, Q. (2019). Econometrics of auctions and nonlinear pricing. *Annual Review of Economics*, *11*, 27-54.

Reiley, D. H. (2006). Field experiments on the effects of reserve prices in auctions: More magic on the internet. *The RAND Journal of Economics*, *37*(1), 195-211.

Rhuggenaath, J., Akcay, A., Zhang, Y., & Kaymak, U. (2022). Setting reserve prices in second-price auctions with unobserved bids. *INFORMS Journal on Computing*, *34*(6), 2950-2967.

Riley, J. G., & Samuelson, W. F. (1981). Optimal auctions. *American Economic Review*, *71*(3), 381-392.

Roth, A.E. (2015). *Who gets what—and why: The new economics of matchmaking and market design.* Houghton Mifflin Harcourt.

Rothkopf, M.H., Teisberg, T.J., & Kahn, E.P. (1990). Why are Vickrey auctions rare? *Journal of Political Economy*, *98*(1), 94-109.

Scott, D. W. (1992). *Multivariate density estimation: Theory, practice, and visualization.* John Wiley & Sons.

Vickrey, W. (1961). Counterspeculation, auctions, and competitive sealed tenders. *Journal of Finance*, *16*(1), 8-37.

Xu, J., Lee, K. C., Li, W., Qi, H., & Lu, Q. (2015). Smart pacing for effective online ad campaign optimization. In *Proceedings of the 21th ACM SIGKDD International Conference on Knowledge Discovery and Data Mining*, 2217-2226.

Ye, Z., Zhang, D.J., Zhang, H., Zhang, R., Chen, X., & Xu, Z. (2023). Cold start to improve market thickness on online advertising platforms: Data-driven algorithms and field experiments. *Management Science*, *69*(7), 3838-60.

Zhang, W., Kitts, B., Han, Y., Zhou, Z., Mao, T., He, H., Pan, S., Flores, A., Gultekin, S., & Weissman, T. (2021). Meow: A space-efficient nonparametric bid shading algorithm. In *Proceedings of the 27th ACM SIGKDD Conference on Knowledge Discovery & Data Mining*, 3928-3936.

2. *Google News Articles, Blog, and Help Pages*

Bellack, J., Exchange Bidding now available to all customers using DoubleClick for Publishers, Google Ad Manager (Apr. 4, 2018), https://blog.google/products/admanager/exchange-bidding-now-available-to-a.

Bellack, J., Smarter optimizations to support a healthier programmatic market, Google Ad Manager (May 12, 2016), https://blog.google/products/admanager/smarter-optimizations-to-suppor.

Bigler, J., An update on first price auctions for Google Ad Manager, Google Ad Manager (May 10, 2019), https://blog.google/products/admanager/update-first-price-auctions-google-ad-manager.

Bigler, J. Rolling out first price auctions to Google Ad Manager partners, Google Ad Manager (Sep. 5, 2019), https://blog.google/products/admanager/rolling-out-first-price-auctions-google-ad-manager-partners.

Cox, S., Simplifying programmatic: first price auctions for Google Ad Manager, Google Ad Manager (Mar. 6, 2019), https://blog.google/products/admanager/simplifying-programmatic-first-price-auctions-google-ad-manager.

Google, 10 Tips for Google Ads Budget Management, Google Ads Resources (Mar. 20, 2023), https://ads.google.com/intl/en_us/home/resources/articles/stretching-your-google-ads-budget.

Google, 2019 Google Ad Manager releases archive, Google Ad Manager Help (Jul. 1, 2019), https://support.google.com/admanager/answer/9197913?hl=en#expand&expand070119.

Google, 2022 Google Ad Manager releases archive, Google Ad Manager Help, https://support.google.com/admanager/answer/11586212?hl=en#zippy=%2Cjune-optimize-pricing-video-protections-troubleshooting-for-mcm-google-analytics-integration-webview-api-for-ads-updates-to-bid-rejection-reason.

Google, Ad Manager report metrics, Google Ad Manager Help (accessed Sep. 29, 2023), https://support.google.com/admanager/table/7568664?hl=en.

Google, Ad-serving Protections for Teens, Google Ad Manager and Ad Exchange Program Policies (accessed Jun. 26, 2024), https://support.google.com/admanager/answer/12171027?hl=en&sjid=2354124647482356745-EU.

Google, Bid data sharing, Authorized Buyers Help (accessed Jul. 24, 2024), https://support.google.com/authorizedbuyers/answer/2696468?hl=en.

Google, Bids data in Ad Manager Data Transfer (Beta), Google Ad Manager Help (accessed Jul. 24, 2024), https://support.google.com/admanager/answer/7357436?hl=en.

Google, Block general categories, Google Ad Manager Help (accessed Jul. 17, 2024), https://support.google.com/admanager/answer/2913554?sjid=261789886268128879-EU.

Google, Block sensitive categories, Google Ad Manager Help (accessed Jun. 25, 2024), https://support.google.com/admanager/answer/2541069?sjid=14973969736947852707-EU.

Google, Coming soon: April 17, 2023 edition, Display & Video 360 announcements (Apr. 17, 2023), https://support.google.com/displayvideo/answer/13511229.

Google, Create a campaign, Display & Video 360 Help (accessed Mar. 12, 2024), https://support.google.com/displayvideo/answer/7205081?hl=en.

Google, Create a Display campaign, Google Ads Help (accessed Mar. 12, 2024), https://support.google.com/google-ads/answer/10759203.

Google, Custom bidding overview and limitations, Display & Video 360 Help (accessed Oct. 31, 2023), https://support.google.com/displayvideo/answer/9723477?hl=en.

Google, Delivery basics: Ad competition with dynamic allocation, Google Ad Manager Help (accessed Jan. 8, 2024), https://support.google.com/admanager/answer/3721872?hl=en.

Google, Determine a bid strategy based on your goals, Google Ads Help (accessed Oct. 31, 2023), https://support.google.com/google-ads/answer/2472725.

Google, DFP and dynamic allocation, DoubleClick for Publishers Help (captured on Sep. 22, 2015), https://web.archive.org/web/20150922150140/https://support.google.com/dfp_premium/answer/3447903.

Google, Display & Video 360: An integrated solution for end-to-end advertising campaigns, Display & Video 360 (accessed Oct. 31, 2023), https://services.google.com/fh/files/misc/display_and_video_360_product_overview.

Google, Display & Video 360 Overview (accessed Jan. 21, 2024), https://support.google.com/displayvideo/answer/9059464?hl=en.

Google, Enhanced Automation, Display & Video 360 Help (accessed Oct. 31, 2023), https://support.google.com/displayvideo/answer/6130826?hl=en.

Google, Evaluate and Optimize Your Bids, Google Ads Help (accessed Oct. 31, 2023), https://support.google.com/google-ads/answer/7085711?hl=en.

Google for Developers, Cookie Matching, Real-time Bidding (accessed Jul. 17, 2024), https://developers.google.com/authorized-buyers/rtb/cookie-guide.

Google, Get Comprehensive Yield Management with Google Ad Manager, Google Ad Manager (accessed Oct. 25, 2023), https://admanager.google.com/home/resources/feature-brief-yield-management.

Google, Google Ads (accessed Jan. 5, 2024), https://ads.google.com/intl/en_us/home.

Google, Google Closes Acquisition of DoubleClick, News from Google (Mar. 11, 2008), http://googlepress.blogspot.com/2008/03/google-closes-acquisition-of_11.

Google, Google Platform Services Terms and Conditions, Google (accessed Sep. 27, 2023), https://www.google.com/google-ad-manager/platform/terms.

Google, How Active View metrics are calculated, Google Ad Manager Help (accessed Sept. 29, 2023), https://support.google.com/admanager/answer/6233478?hl=en&ref_topic=7506202.

Google, How Authorized Buyers Work With Google Ad Manager, Google Ad Manager Resources (accessed Sep. 27, 2023), https://admanager.google.com/home/resources/how_authorized_buyers_work_with_google.

Google, Impressions: Definition, Google Ads Help (accessed Dec. 16, 2023), https://support.google.com/google-ads/answer/6320?hl=en.

Google, Improved header bidding support in Google Ad Manager, Google Ad Manager Blog (Apr. 27, 2022), https://blog.google/products/admanager/improved-header-bidding-support-in-google-ad-manager.

Google, Introduction to Open Bidding, Google Ad Manager Help (accessed Oct. 31, 2023), https://support.google.com/admanager/answer/7128453?hl=en.

Google, Line item types and priorities, Google Ad Manager Help (accessed Jan. 7, 2024), https://support.google.com/admanager/answer/177279?hl=en.

Google, Optimize floor prices in unified pricing rules (Beta), Google Ad Manager Help, https://support.google.com/admanager/answer/11385824.

Google, Run a Manual Experiment, Google Ad Manager Help (accessed Jun. 26, 2024), https://support.google.com/admanager/answer/9799933?hl=en#zippy=%2Cuser-messages%2Cnative-ad-style%2Cunified-pricing-rules%2Cyield-groups%2Cheader-bidding-trafficking-for-prebid.

Google, Set a fixed CPM bid for a line item, Display & Video 360 Help (accessed Jul. 24, 2024), https://support.google.com/displayvideo/answer/2696858?hl=en.

Google, System maximums and limits, Google Ad Manager Help Center (accessed Jun. 26, 2024), https://support.google.com/admanager/answer/1628457?hl=en.

Google, Tag an ad request for child-directed treatment (TFCD), Google Ad Manager and Ad Exchange Program Policies (accessed Jun. 24, 2024), https://support.google.com/admanager/answer/3671211?hl=en&ref_topic=28145.

Google, Targeting types, Google Ad Manager Help (accessed Jun. 26, 2024), https://support.google.com/admanager/answer/2884033?sjid=5613954590018599404-NC#custom-targeting.

Google, Test Campaigns with Ease with Ads Experiments, Google Ads (accessed Jun. 26, 2024), https://ads.google.com/intl/en_us/home/tools/experiments.

Google, [UA] Latency and why it impacts Google Ads Clicks and Analytics Sessions, Google Analytics Help (accessed Jul. 24, 2024), https://support.google.com/analytics/answer/4589209?hl=en.

Google, Understand Video Solutions report metrics, Google Ad Manager Help (accessed Jul. 24, 2024), https://support.google.com/admanager/answer/2759433#video-viewership.

Google, Unified First-Price Auction - Best practices, Google Ad Manager (accessed Jun. 15, 2024), https://services.google.com/fh/files/misc/unified_first-price_auction_best_practices.

Google, Unified pricing rules, Google Ad Manager Help (accessed Jun. 25, 2024), https://support.google.com/admanager/answer/9298008.

Google, Use frequency capping, Google Ads Help (accessed Jul. 24, 2024), https://support.google.com/google-ads/answer/6034106.

Google, Value CPM, Google Ad Manager (accessed Oct. 15, 2023), https://support.google.com/admanager/answer/177222?hl=en.

Hedrick, L., Get Actionable Measurement with Display & Video 360's Insights Module (Nov. 15, 2018), Google Marketing Platform, https://blog.google/products/marketingplatform/360/get-actionable-measurement-display-video-360s-insights-module.

Hsiao, S., How our display buying platforms share revenue with publishers, Google Ad Manager (Jun. 23, 2020), https://blog.google/products/admanager/display-buying-share-revenue-publishers.

Levitte, G., Improved header bidding support in Google Ad Manager, Google Ad Manager (Apr. 27, 2022), https://blog.google/products/admanager/improved-header-bidding-support-in-google-ad-manager.

Ramaswamy, S., Introducing simpler brands and solutions for advertisers and publishers, Google Blog (Jun. 27, 2018), https://blog.google/technology/ads/new-advertising-brands.

Sivasubramanian, V., Help me with Waterfall setup and understanding Passback Tags, Google Ad Manager Help (Mar. 5, 2019), https://support.google.com/admanager/thread/2065360/help-me-with-waterfall-setup-and-understanding-pa ssback-tags?hl=en.

3. *News Articles*

AdExchanger, Google's Scott Spencer On DoubleClick Ad Exchange Auction And Data Management, AdExchanger (Feb. 9, 2010), https://www.adexchanger.com/ad-exchange-news/googles-scott-spencer-on-doubleclick-ad-exchange-auction-and-data-management.

Benes, R. Ad buyer, beware: How DSPs sometimes play fast and loose, Digiday (May 25, 2017), https://digiday.com/marketing/dsp-squeeze-buyers.

Benes, R., Five Charts: The State of Header Bidding, eMarketer Insider Intelligence (May 30, 2019), https://www.insiderintelligence.com/content/five-charts-the-state-of-header-bidding.

Benes, R., Unraveling header bidding's problems with user data, Digiday (Mar. 20, 2017), https://digiday.com/media/header-bidding-security.

Chen, Y., WTF is supply path optimization?, Digiday (May 22, 2023), https://digiday.com/media/what-is-supply-path-optimization.

Cross, T., Who Invented What in Ad Tech? – Part Two, VideoWeek (Jun. 26, 2018), https://videoweek.com/2018/06/26/who-invented-what-in-ad-tech-part-two.

Curran, J., Opinion: For Publishers, Header Bidding Discrepancies Can Outweigh Revenue Lift, AdExchanger (Jul. 8, 2016), https://www.adexchanger.com/the-sell-sider/publishers-header-bidding-discrepancies-can-outweigh-revenue-lift.

Davies, J., What to know about Google's implementation of first-price ad auctions, Digiday (Sep. 6, 2019), https://digiday.com/media/buyers-welcome-auction-standardization-as-google-finally-goes-all-in-on-first-price.

Digiday, In programmatic, buyers sometimes don't know what type of auction they're bidding in, Digiday (Jun. 30, 2017), https://digiday.com/marketing/ad-buyers-programmatic-auction.

Jatain, V., Understanding Header Bidding And How To Leverage It, Forbes (Sep. 17, 2019), https://www.forbes.com/sites/forbescommunicationscouncil/2019/09/17/understanding-header-bidding-and-how-to-leverage-it/?sh=332097315c18.

Joseph, S., Ad-buying agencies are cozying up to SSPs, creating more transparency questions, Digiday (Mar. 31, 2020), https://digiday.com/marketing/ad-buying-agencies-are-cozying-up-to-ssps-creating-more-transparency-questions.

Joseph, S., DSPs are cracking down on bid duplication, Digiday (May 12, 2020), https://digiday.com/media/dsps-are-cracking-down-on-bid-duplication.

Joseph, S., To reduce auction duplication, buyers start to enforce sellers.json, Digiday (Oct. 16, 2019), https://digiday.com/media/reduce-auction-duplication-buyers-start-enforce-sellers-json.

Joseph, S., WTF are post-auction discounts?, Digiday (Apr. 2 2020), https://digiday.com/media/post-auction-discounts.

Kaplan, D., On Ad Networks: Pork Bellies, Diamonds, Or The New Direct Marketing?, Forbes (Apr. 8, 2008), https://www.forbes.com/2008/04/08/online-ad-networks-tech-cx_pco_0408paidcontent.html?sh=7414ef02cb8e.

Ong, J., Adtech firm OpenX unveils an industry-changing fusion of real-time bidding and ad networks, The Next Web News (Jun. 9, 2014), https://thenextweb.com/news/adtech-firm-openx-unveils-industry-changing-fusion-real-time-bidding-ad-networks.

Poncz, O., Traffic duplication might be a bigger problem than ad fraud, AdExchanger (Jan. 11, 2016), https://www.adexchanger.com/data-driven-thinking/traffic-duplication-might-even-be-a-bigger-problem-than-ad-fraud.

Sluis, S., Attack Of The Clones: Programmatic's Hidden Scourge Of Bid Duplication, AdExchanger (Jan. 17, 2024), https://www.adexchanger.com/platforms/attack-of-the-clones-programmatics-hidden-scourge-of-bid-duplication.

Sluis, S., Big Changes Coming To Auctions, As Exchanges Roll The Dice On First-Price, AdExchanger (Sep. 5, 2017), https://www.adexchanger.com/platforms/big-changes-coming-auctions-exchanges-roll-dice-first-price.

Sluis, S., Everything You Need To Know About Bid Shading, AdExchanger (Mar. 15, 2019), https://www.adexchanger.com/online-advertising/everything-you-need-to-know-about-bid-shading.

Sluis, S., Explainer: More On The Widespread Fee Practice Behind The Guardian's Lawsuit Vs. Rubicon Project, AdExchanger (Mar. 30, 2017),

https://www.adexchanger.com/ad-exchange-news/explainer-widespread-fee-practice-behind-guardians-lawsuit-vs-rubicon-project.

Sluis, S., Google Ad Manager Builds A Bridge To Prebid—But Don't Call It A Two-Way Street, AdExchanger (Apr. 27, 2022), https://www.adexchanger.com/platforms/google-ad-manager-builds-a-bridge-to-prebid-but-dont-call-it-a-two-way-street.

Sluis, S., Google Ad Manager Policy Changes Don't Hurt Publishers, According to Advertiser Perceptions, AdExchanger (May 5, 2020), https://www.adexchanger.com/platforms/google-ad-manager-policy-changes-dont-hurt-publishers-according-to-advertiser-perceptions.

Sluis, S., Google Removes Its 'Last-Look' Auction Advantage, AdExchanger (Mar. 31, 2017), https://www.adexchanger.com/platforms/google-removes-last-look-auction-advantage.

Sluis, S., Header Bidding Unleashed a Huge Infrastructure Problem and Ad Tech Will Either Sink or Swim, AdExchanger (Apr. 24, 2017), https://www.adexchanger.com/platforms/header-bidding-unleashed-huge-infrastructure-problem-ad-tech-will-either-sink-swim.

Sluis, S., OpenX Lays Off 100 Employees And Pivots To Video, AdExchanger (Dec. 18, 2018), https://www.adexchanger.com/platforms/openx-lays-off-100-employees-and-pivots-to-video.

Sluis, S., The Trade Desk suppresses bid duplication amid COVID-19 traffic surge, AdExchanger (Apr. 21, 2020), https://www.adexchanger.com/platforms/the-trade-desk-suppresses-bid-duplication-amid-covid-19-traffic-surge.

Story, L., DoubleClick to Set Up an Exchange for Buying and Selling Digital Ads, New York Times (Apr. 4, 2007), https://www.nytimes.com/2007/04/04/business/media/04adco.html.

4. *Other Websites and Material*

Abhilasha, The Ultimate Guide to Open Bidding for Publishers, headerbidding.co (Jul. 25, 2023), https://headerbidding.co/open-bidding-ultimate-guide.

Ad Ops Insider, Header Bidding Explained Step-by-Step (Jun. 8, 2015), https://www.adopsinsider.com/header-bidding/header-bidding-step-by-step.

Ad.Plus, Header Bidding vs Open Bidding, Ad.Plus Blog (Jan. 6, 2023), https://blog.ad.plus/header-bidding-vs-open-bidding.

AdPushup, Header Bidding (2023), https://www.adpushup.com/header-bidding-guide.

AffiliateSeeking.com, Ad Networks (captured on Jan. 16, 2008), https://web.archive.org/web/20080116101025/https://www.affiliateseeking.com/list/23000001/1.

Amazon, Unified Ad Marketplace, Amazon Publisher Services (accessed Sep. 12, 2023), https://aps.amazon.com/aps/unified-ad-marketplace/index.

American Economic Association, Paul Milgrom, Distinguished Fellow 2020, American Economic Association (2020), https://www.aeaweb.org/about-aea/honors-awards/distinguished-fellows/paul-milgrom.

Athey, S., Economics 980: Topics in Market Design, Stanford University (accessed Sept. 27, 2023), https://gsb-faculty.stanford.edu/susan-athey/economics-980-topics-market-design.

Auctionomics and Power Auctions, Incentive Auction Rules Option and Discussion, FCC (Sep. 12, 2012), https://docs.fcc.gov/public/attachments/FCC-12-118A2.

Bentahar, A., Bid Adjustments Simplified: Run Fair Auctions with no Hassle, Pubstack (May 2, 2021), https://www.pubstack.io/topics/bid-adjustments-simplified.

Bhatia, S., Google Open Bidding (OB) Explained, AdSparc (Apr. 12, 2022), https://adsparc.com/google-open-bidding-explained.

Bidgear, A Well Organized Passback Strategy (Aug. 7, 2016), https://bidgear.com/blog/a-well-organized-passback-strategy-24.

Clickio, Monetization (accessed Jul. 7, 2024), https://clickio.com/monetization.

Criteo S.A., Form 10-K, United States Securities and Exchange Commission (2022), https://www.sec.gov/Archives/edgar/data/1576427/000157642723000023/crto-20221231.

Criteo, What You Need to Know About First-Price Auctions and Criteo, Criteo Updates (Sep. 26, 2023), https://www.criteo.com/blog/first-price-auctions.

Das, H., Header Bidding vs Open Bidding – What Should You Know!, headerbidding.co Blog (Feb. 23, 2024), https://headerbidding.co/header-bidding-vs-open-bidding.

Doherty, W., The door in the floors: Transparency, price discovery, and market efficiency in programmatic, The Current (Nov. 8, 2023), https://www.thecurrent.com/will-doherty-transparency-programmatic-data.

DoubleClick for Publishers, Terminology differences with DART, DoubleClick for Publishers Help (captured Feb. 11, 2012), https://web.archive.org/web/20120211164005/http://support.google.com/dfp_premium/bin/answer.py?hl=n&answer=158833.

DoubleVerify, Latency in Digital Advertising: A Guide for Publishers, DV Publisher Insights (Oct. 21, 2019), https://pub.doubleverify.com/blog/latency-in-digital-advertising-a-guide-for-publishers.

INFORMS, About AMD - Auctions and Market Design (accessed Sept. 27, 2023), http://connect.informs.org/auctionsandmarketdesign/about-us/aboutamd.

IAB Tech Lab, OpenRTB (Jul. 27, 2020), https://iabtechlab.com/standards/openrtb.

Interactive Advertising Bureau, Glossary: Digital Media Buying & Planning (Apr. 2016), https://www.iab.com/wp-content/uploads/2016/04/Glossary-Formatted.

Laurendon, L., Google Unified First Price Auction Explained, Smart Ad Server Blog (captured on Mar. 7, 2022), http://web.archive.org/web/20220307203150/https://smartadserver.com/articles/google-unified-first-price-auction-explained.

Magnite Team, Magnite Unveils New Demand Manager Feature Powered by Machine Learning to Help Publishers Earn Incremental Revenue, Magnite (Oct. 5, 2023), https://www.magnite.com/press/magnite-unveils-demand-manager-machine-learning-feature.

Media Rating Council, Minimum Standards for Media Rating Research, Media Rating Council (accessed Sep. 29, 2023), https://mediaratingcouncil.org/standards-and-guidelines.

Meta, Code of Conduct, Meta Audience Network (accessed Dec. 2, 2023), https://www.facebook.com/audiencenetwork/partner-program/code-of-conduct.

Microsoft, Discover the possibilities with experiments, Microsoft Advertising (accessed Jun. 26, 2024), https://help.ads.microsoft.com/apex/index/3/en/56908.

Milgrom, P. R., Cunningham, S. J., & Beck, M. R. (2023). U.S. Patent No. 11,574,358-B2. Washington, DC: U.S. Patent and Trademark Office.

Munson, B., Comcast's FreeWheel launches unified ad decisioning, StreamTV Insider (Apr. 15, 2020), https://www.streamtvinsider.com/tech/comcast-s-freewheel-launches-unified-ad-decisioning.

Naylon, Jenna, Media Planning and Buying Strategies: The Importance of Test & Learn, MatrixPoint (accessed Jul. 17, 2024), https://www.thematrixpoint.com/resources/articles/media-planning-and-buying-strategies-the-importance-of-test-learn.

NBER, Market Design (2023), https://www.nber.org/programs-projects/programs-working-groups%23Groups/market-design.

Nolet, M., RTB Part II: Supply supply supply!, Mike On Ads (Sep. 19, 2009), http://www.mikeonads.com/2009/09/19/rtb-part-ii-supply-supply-supply.

OpenX, Google & OpenX Release Study Showing Publisher Partners Experience 48% Revenue Lift Through Google Exchange Bidding Collaboration (Feb. 15, 2018), https://www.openx.com/press-releases/google-openx-revenue-lift.

OpenX, Selling rules (Dec. 12, 2016), https://web.archive.org/web/20170708051049/https://docs.openx.com/Content/publishers/userguide_inventory_realtimeselling.

OpenX, OpenX transforms concept of SSP with industry-first demand fusion technology (Jun. 9, 2014), https://www.openx.com/press-releases/openx-transforms-concept-of-ssp-with-industry-first-demand-fusion-technology.

Prebid.org, About (accessed Jul. 25, 2024), https://prebid.org/about.

Prebid.org, Prebid.js Ad Ops (accessed Jul. 24, 2024), https://docs.prebid.org/adops/price-granularity.html#prebid-default-price-granularities.

Prebid.org, Prebid.js FAQ (accessed Dec. 1, 2023), https://docs.prebid.org/dev-docs/faq.

Prebid.org, Prebid.js Publisher API Reference (accessed Jul. 24, 2024), https://docs.prebid.org/dev-docs/publisher-api-reference/setConfig.html#setConfig-Cpm-Rounding.

Prebid.org, Price Granularity (accessed Jul. 12, 2024), https://docs.prebid.org/adops/price-granularity.

Prebid.org, Running Prebid.js without an ad server (accessed Sep. 7, 2023), https://docs.prebid.org/dev-docs/examples/no-adserver.

Pubmatic, Pubmatic SSP: Maximize Advertising Revenue and Control How Your Audiences are Accessed, Pubmatic (accessed Oct. 25, 2023), https://pubmatic.com/products/pubmatic-ssp-for-publishers.

Refinitiv Streetevents, Q2 2021 Magnite Inc Earnings Call (Aug. 5, 2021), https://investor.magnite.com/static-files/950ded3e-8953-4cf9-a043-d0e72b1fb856.

Scipy, scipy.spatial.ConvexHull, SciPy v1.11.4 Manual (accessed Jan. 10, 2024), https://docs.scipy.org/doc/scipy/reference/generated/scipy.spatial.ConvexHull.

SciPy, scipy.stats.gaussian_kde, SciPy v1.11.4 Manual (accessed Dec. 3, 2023), https://docs.scipy.org/doc/scipy/reference/generated/scipy.stats.gaussian_kde.

Semret, N., Introducing Minimum CPM Recommendations on DoubleClick Ad Exchange, DoubleClick Publisher Blog (Nov. 1, 2011), https://doubleclick-publishers.googleblog.com/2011/11/introducing-minimum-cpm-recommendations.

SLMath, Mathematics and Computer Science of Market and Mechanism Design (2023), https://www.slmath.org/programs/333.

Stack Overflow, What are advertising passback tags and common implementation (Feb. 19, 2014), https://stackoverflow.com/questions/19112923/what-are-advertising-passback-tags-and-common-implementation.

Stanford University, Stanford Bulletin (2023), https://explorecourses.stanford.edu/search;jsessionid=zg9iqiunv63g16z0qr48bmb90?q=ECON+136%3a+Market+Design&view=catalog&filter-coursestatus-Active=on&academicYear=20232024.

The Royal Swedish Academy of Sciences, The quest for the perfect auction, Nobelprize.org (2020), https://www.nobelprize.org/uploads/2020/09/popular-economicsciencesprize2020.

The Trade Desk, DFP Features: Integrated planning and activation (accessed Oct. 31, 2023), https://www.thetradedesk.com/us/our-platform/dsp-demand-side-platform/plan-campaigns.

The Trade Desk, Conversion Lift: What it is, how it works, and best practices (Aug. 23, 2023), https://www.thetradedesk.com/us/resource-desk/best-practices-for-better-conversion-lift.

Xandr, Publisher Platforms, Microsoft Advertising (accessed Oct. 25, 2023), https://about.ads.microsoft.com/en-us/solutions/xandr/publisher-platforms-scaled-buying-selling-solutions.

Xandr, Seller Best Practices (May 5, 2023), https://docs.xandr.com/bundle/industry-reference/page/seller-best-practices.

Xandr, Understanding Optimization, Xandr Documentation Center (Feb. 7, 2022), https://docs.xandr.com/bundle/monetize_monetize-standard/page/topics/understanding-optimization.

Yahoo, Verizon Media Is Now Yahoo (Sep. 1, 2021), https://www.advertising.yahooinc.com/post/verizon-media-is-now-yahoo.

Zawadziński, M., How Does Real-Time Bidding (RTB) Work?, Clearcode Blog (Jul. 2, 2021), https://clearcode.cc/blog/real-time-bidding.

Zawadziński, M. & Sweeney, M., What is cookie syncing and how does it work?, Clearcode Blog (Jan. 31, 2024), https://clearcode.cc/blog/cookie-syncing.

Zawadziński, M. & Sweeney, M., What is Waterfalling and How Does it Work?, Clearcode Blog (Sep. 1, 2016), https://clearcode.cc/blog/what-is-waterfalling.